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An Extended Theory of Planned Behavior for Parent-for-Child Health Behaviors: A Meta-Analysis

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Abstract

Objective: To conduct a meta-analysis of studies examining the determinants of behaviors performed by parents to promote the health of their child, termed parent-for-child health behaviors, based on an extended theory of planned behavior. Specifically, the study aimed to meta-analyze correlations among theory of planned behavior constructs, planning, and past behavior, and use them to test theory predictions and effects of salient moderators. **Methods:** A systematic search identified 46 studies that provided correlations between at least one theory construct and intention or behavior for parent-for-child behaviors. Theory predictions were tested using meta-analytic structural equation modeling. Studies were also coded for candidate moderators of model effects: child age, sample type, time lag between measures of theory constructs and parent-for-child health behavior, study quality, and behavior type, and estimated the proposed model at each level of the moderator. **Results:** Results supported theory predictions with attitudes, subjective norms, and perceived behavioral control predicting parent-for-child health behavior participation mediated by intention. Perceived behavioral control and planning also directly predicted behavior, and planning partially mediated effects of intention on behavior. Model effects held when controlling for past behavior, supporting the sufficiency of the theory in this behavioral domain. Few moderator effects were found on relations between theory constructs. **Conclusions:** Findings identified the social cognition determinants of parent-for-child health behaviors, and highlight the potential processes by which they relate to behavior. The current model signposts potentially modifiable targets for behavioral interventions aimed at fostering parental participation in behaviors that promote the health of their children.

Keywords: Child behavioral health; Parental influence; Social cognition theory; Action planning; Dual-phase models; Meta-analytic structural equation modeling

REGISTRATION: Prospero registry of systematic reviews identifier: CRD42016043081

An Extended Theory of Planned Behavior for Parent-for-Child Health Behaviors: A Meta-Analysis

Noncommunicable diseases such as cardiovascular disease, cancer, respiratory diseases, and diabetes are implicated in 71% of all deaths globally (GBD 2015 Collaborators, 2016; WHO, 2018). Modifiable behavioral risk factors such as physical inactivity and unhealthy diets are related to increased risk of non-communicable disease, whereas regular participation in health-promoting behaviors are associated with reduced chronic disease risk (Li et al., 2018). Based on this evidence, the World Health Organization (WHO) has proposed a global action plan aimed at reducing the burden of morbidity, mortality, and disability attributed to non-communicable disease (WHO, 2013). The plan highlights the importance of policies and initiatives that reduce exposure to common modifiable risk factors for chronic disease, while strengthening individuals' capacity to adopt healthy lifestyle behaviors. While the deleterious effects of non-communicable disease manifest in adulthood, childhood is a key period where exposure to risk factors begins and likely continues throughout life, underpinning the importance of adopting a life-course approach to health promotion (WHO, 2013).

It is well-documented that the development of efficacious health promotion programs necessitates identification of modifiable behavioral determinants to be targeted in behavior change interventions (Hagger, Cameron, Hamilton, Hankonen, & Lintunen, 2020; Johnson & Acabchuk, 2018; Rothman et al., 2015). Application of theories of social cognition has demonstrated utility in identifying these determinants. Prominent among these theories is the theory of planned behavior (Ajzen, 1991), a social cognition theory that has been applied extensively to predict multiple health behaviors. The theory identifies the belief-based constructs that are proposed to determine future behavioral engagement. Intention is a focal construct of the theory and represents the extent to which an individual is motivated to perform a given target behavior in future. Intention is posited as the most proximal predictor of behavior. Intention is a function of three belief-based constructs: attitudes (evaluation of the benefits and detriments of the behavior), subjective norms (beliefs that significant others support performing the behavior), and perceived behavioral control (perceived capacity to carry out the behavior). In addition, to the extent that perceived behavioral control reflects actual control, it is also proposed to directly predict behavior. Inclusion of past behavior as an additional predictor of intention and behavior is also considered important in order to test the sufficiency of the theory (Ajzen, 1991).

Although the theory of planned behavior has shortcomings, particularly its focus on static prediction rather than dynamic change in behavior (Sniehotta, Presseau, & Araújo-Soares, 2014), meta-analytic studies generally supported theory predictions, accounting for substantive variance in intention and behavior in multiple health contexts (e.g., McEachan, Conner, Taylor, & Lawton, 2011; Rich, Brandes, Mullan, & Hagger, 2015). However, the model has mainly been applied to the prediction of behaviors that promote individual health. Emerging research has demonstrated that the model may also be useful for understanding individuals' decisions for others' health, including parents'[1] behaviors to promote the health of their child or children, hereafter referred to as parent-for-child health behaviors (for a review see Hagger & Hamilton, 2019). Children, particularly very young children, tend to rely extensively, or exclusively, on parents performing behaviors that support their health (e.g., breastfeeding, applying sunscreen, cooking healthy meals). Parents also act as 'gatekeepers' of children's health behavior, by, for example, providing transport or resources (e.g., transporting children to the swimming pool, paying for dance lessons). Parents also influence children's motivation to participate in health behaviors through modeling. Previous research has demonstrated the effectiveness of the theory of planned behavior in identifying the determinants of parent-for-child health behaviors. For example, research applying the theory has shown parents' attitudes and perceptions of social pressure and control to be important predictors of their intentions toward, and participation in, parent-for-child health behaviors (Andrews, Silk, & Eneli, 2010; Hamilton, Kirkpatrick, Rebar, & Hagger, 2017; Hamilton, Spinks, White, Kavanagh, & Walsh, 2016).

[1]In the context of the present study, we defined 'parent' as any full-time caregiver of a child including their biological parents as well as biological or non-biological caregivers.

Although the majority of research applying the theory of planned behavior has identified intentions to be a consistent determinant of parent-for-child behaviors, the relationship between intentions and behavior is far from perfect (Andrews et al., 2010; Hamilton, Kirkpatrick, Rebar, & Hagger, 2017; Hamilton, Spinks, et al., 2016). These findings are indicative of a substantive intention-behavior 'gap', similar to that identified in research applying the theory to health behavior more broadly (Orbell & Sheeran, 1998; Rhodes & de Bruijn, 2013). This shortfall in the predictive capacity of intentions likely reflects the influence of barriers, distractions, or competing demands that thwart intention enactment (Hamilton, Cleary, White, & Hawkes, 2016; Hamilton, Hatzis, Kavanagh, & White, 2015). Therefore, parents of young children need to be equipped with the means to manage these obstacles and follow-through on their intentions to perform parent-for-child health behaviors.

One self-regulatory strategy that may lead individuals to effectively enact on their intentions is planning. Dual phase models of behavior such as the health action process approach suggest that individuals who have formed intentions in an initial 'volitional' phase need to subsequently furnish their intentions with *action plans* in order to carry them out (Schwarzer, 2008; Schwarzer & Hamilton, 2020). Action plans involve identifying specific environmental contingencies that 'cue-up' the desired behavior and linking them to the behavior. Successful planners are proposed to be more effective in enacting their intentions, and it may be that individuals who are effective in carrying out their intentions are intuitively 'good' at planning. Consistent with this proposition, research adopting the health action process approach has indicated that action plans mediate effects of intentions on health behavior (Zhang, Zhang, Schwarzer, & Hagger, 2019). Similarly, research suggests that prompting individuals to form action plans leads to better behavioral enactment (Hagger, Luszczynska, et al., 2016). In the context of parent-for-child health behaviors, evidence is emerging that planning mediates the intention-behavior relationship (Hamilton, Cornish, Kirkpatrick, Kroon, & Schwarzer, 2018; Hamilton, Kothe, Mullan, & Spinks, 2017; Hamilton & Schwarzer, 2018), and suggests this is an important process by which parents enact these behaviors.

The Present Study

Given the importance of parental participation in health-promoting behaviors for their children to long-term child health (Hagger & Hamilton, 2019), identifying the key theory-based determinants of parent-for-child health behaviors may provide important evidence on which to base interventions to promote participation in these behaviors. The purpose of the present study was to synthesize research applying the theory of planned behavior to predict parents' participation in behaviors supporting the health of their child, and test theory-related predictions using meta-analytic structural equation modeling. The analysis will also test effects of planning on parents' participation in health-promoting behaviors for their children. Consistent with theory, it was expected that attitudes, subjective norms, and perceived behavioral control would predict parents' intention to perform parent-for-child health behaviors, intention and perceived behavioral control would predict behavior, and that intention would mediate effects of attitudes, subjective norms, and perceived behavioral control on behavior. Intention was also expected to predict planning directly consistent with theory, and for planning to predict behavior independent of the theory of planned behavior constructs. It was also expected that planning would mediate effects of intention on behavior, consistent with dual phase models. Finally, it was expected that all predictions would hold when controlling for past behavior.

Although the theory of planned behavior assumes that the determinants of behavior will be consistent across contexts, populations, and behaviors, theory and research suggests that the relative contribution of these constructs may vary according to specific contextual or sample-related factors. We therefore aimed to examine effects of salient moderators on relations among model constructs, particularly the intention-behavior relationship for parent-for-child health behaviors in the current study. Candidate moderators include demographic (age of child, sample type), methodological (time lag between measures of theory constructs and behavior, study quality), and conceptual (behavior type). Behavior type, in particular, is a key moderator. Current findings are expected to test whether the pattern of effects among theory constructs is consistent across types of parent-for-child behaviors, or whether certain constructs are more effective in predicting particular behaviors (McEachan et al., 2011; Rich et al., 2015). For example, parents' intentions to perform certain parent-for-child behaviors may be more likely to be determined by subjective norms than others; parents may feel obliged to perform behaviors for their children like limiting screen time and cooking healthy meals due to perceived pressure from others such as the children's grandparents. Conversely, parents' intentions may be more likely to be related to their attitudes toward the valued outcomes that performing the behaviors will likely confer for their child such as protective behaviors like sun screen use or toothbrushing. In these cases, effects of subjective norms and attitudes on intentions and, therefore, the indirect effects of these constructs on behavior through intentions, are likely to be larger for physical activity and dietary behaviors, and health protective behaviors, respectively, compared to other behavior types. Identifying differences in the relative contribution of the constructs to intentions and behavior according to these moderator variables may have ramifications for the selection of variables to target in subsequent experimental or intervention research aimed at changing parent-for-child health intention and behavior (Sheeran et al., 2016).

Method

Search Strategy

The meta-analysis was pre-registered on the Prospero database of systematic reviews: http://www.crd.york.ac.uk/PROSPERO/display_record.php?ID=CRD42016043081. Five electronic databases (EMBASE, Medline, PsycINFO, Scopus, and Web of Science) were systematically searched to identify studies testing effects of constructs from the theory of planned behavior and related social cognition theories for behaviors performed by parents to promote the health of their child. Thus, included studies focused exclusively on parental reports of the behaviors they performed for their child (e.g., cooking, prompting, reminding, setting limits, applying sunscreen), and not on parental reports of their child's behaviors (e.g., eating, exercising, watching television, wearing seatbelt). Databases were searched from the earliest possible date through the end of April 2017.

Search terms were developed by the research team to maximize inclusiveness: “theory of planned behavio*” OR “theory of reasoned action” OR “reasoned action approach” OR “social cognitive theory” OR “social cognit* model” OR “social cogn*” OR “health belief model” OR “protection motivation theory” OR “health action process approach” OR “transtheoretical model” AND “guardian*” OR “parent*” OR “child*” OR “care giver” OR “caregiver” OR “care taker*”. Requests for unpublished data were sent by email to society listservs for unpublished research meeting inclusion criteria. A manual search of reference lists of published reviews of the theory of planned behavior was also used to locate additional studies, and a cross-referencing of the bibliographies of the articles obtained was conducted.

Characteristics of Included Studies

Studies were included if (a) participants were parents of children aged between 0 and 12 years (or a mean age of 12 years and younger); and (b) reported at least one effect size between a measure or manipulation of one construct from the theory of planned behavior, including measures of planning, and a measure of intention or behavior in the context of parent-for-child health behavior. Studies that measured or manipulated a theory construct, but did not include an intention or behavior measure were excluded. Articles identified in the initial search after removal of duplicates (k = 4,545) were subjected to a title and abstract screen for eligibility by two members of the research team. The resulting longlist of studies was then subjected to full-text review against inclusion criteria to produce a final set of included studies (k = 49). A PRISMA flow diagram (Moher, Liberati, Tetzlaff, Altman, & the PRISMA Group, 2009) of the study search, screening, and selection process is presented in Appendix A (supplemental materials). Studies using the same data set were consolidated (see Appendix B, supplemental materials). In addition, one study included multiple samples (de Vries, van Osch, Eijmael, Smerecnik, & Candel, 2012), so each sample was treated as a separate study in the analysis resulting in a final sample of 46 studies (see Appendix B, supplemental materials).

Classification of Constructs

Identified studies adopted a range of social cognition theories and models, such as the theories of reasoned action and planned behavior, social cognitive theory, the health belief model, and protection motivation theory. Given the considerable overlap in the definition and operationalization of the component constructs of these theories, as documented elsewhere (Conner, 2015; Fishbein et al., 2001; McMillan & Conner, 2007), measures of these constructs were consolidated into the attitudes, subjective norms, and perceived behavioral control constructs from the theory of planned behavior. For example, constructs representing behavioral beliefs and positive and negative evaluations of the behavior were classified as attitudes, constructs related to normative beliefs and social influence were classified as subjective norms, and beliefs in capacity and self-efficacy were classified as perceived behavioral control. In addition, planning was frequently measured as an additional construct in the current sample of studies on parent-for-child health behaviors, and is pertinent to the determination of these behaviors consistent with theories that adopt a dual phase approach to behavioral prediction (Heckhausen & Gollwitzer, 1987; Schwarzer, 2008). The most frequently used measures of planning were action planning and implementation intentions. Measures of parent-for-child behaviors were exclusively self-report via survey, interview, or verbal reports.

Effect Size Data Extraction

Relevant effect size data (effect size estimates and data relevant to estimating variability) representing relations among the consolidated set of constructs from the extended theory of planned behavior were extracted from included studies. The majority of studies were correlational in design with few intervention or correlational studies targeting change in theory constructs. The zero-order bivariate correlation coefficient was identified as the appropriate effect size metric for the analysis. None of the included studies adopting an experimental or intervention design tested effects of a manipulation targeting change in a single theory of planned behavior or planning construct on parent-for-child behavior. Instead, interventions adopted intervention strategies targeting change in constructs other than those included in the current model (e.g., message framing; Abhyankar, O'Connor, & Lawton, 2008; Fahy & Desmond, 2010). Intervention effects did not, therefore, represent a valid manipulation of one of the model constructs and its effects on another model construct or behavior. As a consequence, data from the control group were used for studies adopting experimental or intervention designs. For studies including measures of behavior at multiple follow-up points, we used behavioral data taken at the time point most distal from baseline measures in our analysis to maximize numbers of studies with longer-range behavioral prediction. In addition to effect size data, sample characteristics (mean age and range of parents and children, gender distribution of parents and children), and operationalization of measures of intention and behavior were also extracted. These data were summarized in Appendix C (supplemental materials). Full characteristics of studies and data extracted are available in a spreadsheet available online: https://osf.io/47efp/.

Moderator coding

The following moderator variables were coded: child age, sample type, time lag between measures of social cognition constructs and the measure of parental health behavior, study quality, and behavior type (moderator coding is summarized in the study characteristics table in Appendix C). Studies were grouped into studies on younger children and infants under 6 years of age, and older children aged 6 years and older. With respect to the behavior type moderator, three types of parent-for-child health behaviors were the target behavior with sufficient frequency to conduct a moderator analysis ($k \geq 10$): physical activity, dietary behaviors, and protection or safety behaviors. Physical activity studies included parents' promoting or encouraging physical activity and exercise behaviors with their children. This category also included discouraging sedentary behaviors such as screen time. Dietary behaviors encompassed all nutrition-related behaviors, including promoting healthy eating such as consumption of fruits and vegetables, breastfeeding, and cooking breakfast, and discouraging unhealthy eating such as snacking and discretionary choices. Protection or safety behaviors included behaviors aimed to reduce health risks of the child such as vaccination, use of car seats, providing medication, sunscreen use, supervised tooth brushing, and injury prevention practices. The sign of the extracted correlations between social cognition constructs and these behaviors was adjusted for consistency in aggregation. Studies were also coded according to sample type, with studies grouped according to whether the sample comprised solely of mothers and female caregivers, and samples comprising both male and female parents and caregivers. Time lag was defined as the time, in weeks, between measures of the social cognition constructs and follow-up measure of parents' behavior for their children. Studies with a time lag of six weeks or fewer were classified as 'proximal' and studies with a lag greater than six weeks were classified as 'distal'. This dichotomized variable was used in subsequent moderator analyses. Studies with no behavioral follow up were excluded from the time lag moderator analysis.

Study quality was assessed using a 20-item checklist developed for correlational research (Hagger, Koch, Chatzisarantis, & Orbell, 2017). Studies meeting stipulated quality standards on each item were assigned a score of 1 and those not meeting standards, or provided insufficient information for evaluation, were assigned a score of 0. Two raters with previous experience in assessing study quality analysis scored the studies. Inter-rater reliability was tested on a set of double-coded studies (k = 10) with good agreement (median agreement = 85%, range = 70% to 100%) and inter-rater reliability based on Gwet's (2008) AC1/AC2 coefficient (median AC1/AC2 coefficient = .779, range = .597 to 1.000, all p's < .042). Studies attaining a quality score at or above a cutoff value of 65% (a score of 13 out of 20 on the checklist) were considered of 'high'/'acceptable' quality as recommended by the checklist authors, while studies attaining scores below 65% were considered of 'low'/'questionable' quality. The dichotomous study quality variable was used in the moderator analysis. For the sake of comparison we also coded alternative study quality moderator variables with more stringent cutoff criteria for 'acceptable' study quality checklist scores at or above 70% and 75%. The checklist criteria and item descriptions are presented in Appendix D (supplemental materials). Quality scores for each study and inter-rater reliability analyses are presented in a spreadsheet available online: https://osf.io/47efp/. Study quality moderator coding is provided in Appendix C (supplemental material).

Data Dependency

Some studies provided multiple behavioral measures and, therefore, multiple effect sizes for behavior. However, inclusion of multiple effect sizes from the same study as separate effects in a meta-analysis violates the assumption of independence. As a consequence, we aggregated these effect sizes using the Agg function the MAc package (Del Re & Hoyt, 2018) in R, which uses Hunter and Schmidt's (2004) formula to deal with within-study dependency. The imputed correlation between the within-study effect sizes was set at $r = .50$ as recommended by Wampold et al. (1997). Details of aggregated studies and the behavioral dependent variables are provided in Table B (Appendix B, supplemental materials). Analysis scripts and output for the aggregation analysis are available online: https://osf.io/47efp/.

Data Analysis

Structural equation models. Relations among constructs in model tests were estimated using meta-analytic structural equation modeling using the MASEM package (Cheung & Hong, 2017) in R. Meta-analytic structural equation modeling is a two-stage approach to testing structural relations in a proposed model using correlations from a meta-analysis. In the first stage, correlation matrices among constructs of the proposed model from each included study are transformed to account for study-specific random effects, enabling them to be analyzed as covariance matrices in a structural equation model. Parameter estimates produced in the first stage represent the zero-order correlations among study constructs corrected for sampling error across studies with 95% confidence intervals. The analysis also provides homogeneity tests for each model parameter: Cochran's (1952) Q, the τ^2 statistic, and I^2 statistic and its 95% confidence interval. Statistically significant Q and τ^2 values with I^2 values exceeding 25% with wide confidence intervals are considered indicative of substantive heterogeneity. Conventional fixed- and random-effects meta-analytic estimates and homogeneity statistics for each correlation were also computed using the metafor package in R for comparison.

In the second stage of the analysis, a model representing predicted relations among study constructs is fitted to the covariance matrix from the first stage. We estimated two structural equation models. A model representing the extended theory of planned behavior that included planning (Figure 1, and a model comprising only the theory of planned behavior constructs excluding planning (Figure 2). We estimated the model excluding planning because the studies that included a measure of planning numbered relatively few, so we were not able to estimate the full model in subsequent moderator analyses. In addition, we estimated separate models that included and excluded past behavior for both versions of the model to examine effects of past behavior on model relations, consistent with recommendations elsewhere (Hagger, Chan, Protogerou, & Chatzisarantis, 2016; Hagger, Polet, & Lintunen, 2018).

Model fit was evaluated using multiple goodness-of-fit indices: the comparative fit index (CFI), the Tucker-Lewis index (TLI), the standardized root mean square of the residuals, and the root mean error of approximation (RMSEA). A non-significant chi-square value, CFI and TLI values that approach or exceed .95, a SRMSR value of less than .08, and a RMSEA value of .05 or less indicate good fit of the model with the data (Hu & Bentler, 1999). Effects among model constructs were evaluated based on the likelihood-based confidence intervals about model parameter estimates. Differences in the effect sizes of the parameter estimates across the models including and excluding past behavior were tested using 95% confidence intervals of the difference in the parameter estimates across the models (Schenker & Gentleman, 2001). To the extent that the interval does not include zero, a statistically significant difference in the parameter estimates across models is confirmed. A formal test of difference is also provided using Welch's *t*-test. Both tests require the use of Wald confidence intervals based on symmetric standard errors.

Moderator analyses. Effects of candidate moderator variables on the proposed relations among constructs in the model were tested by estimating of the model separately in each moderator group. As before, multiple goodness-of-fit indices were adopted to evaluate the adequacy of the model in each moderator group. Differences in model parameter estimates across moderator groups were tested using Schenker and Gentleman's (2001) standard method and Welch's *t*-test.

Assessment of bias. The potential effect of selective reporting bias on relations among model constructs in the current sample of studies was evaluated using regression analyses based on 'funnel' plots of effect size on estimates of precision (Egger, Smith, Schneider, & Minder, 1997). Two methods are used: the precision effect test (PET) and the precision effect estimate with standard error (PEESE). PET and PEESE estimates for each effect size were computed, with accompanying *t*-tests for bias and significance tests of the corrected effect from zero, using the PETPEESE function (Carter, Schonbrodt, Gervais, & Hilgard, 2019) in R.[2]

Results

Zero-order correlations and bias estimates

Correlations. Zero-order averaged bias-corrected correlations (r^+) from the first stage of the MASEM analysis among constructs extracted from the included studies are presented in Table E1 for the theory of planned behavior including planning and Table E2 for the theory of planned behavior without planning (Appendix E, supplemental materials), with bias-corrected correlations from conventional random- and fixed-effects meta-analysis included for comparison (Table F1, Appendix F, supplemental materials). Correlations with 95% confidence intervals that did not include the value of zero were found among all constructs, with small-to-medium-sized effects. In particular, attitudes, subjective norms, perceived behavioral control, and planning were correlated with intention to participate in parent-for-child behaviors, and intention, perceived behavioral control, and planning were correlated with parent-for-child behavior, consistent with theory (Ajzen, 1991; Schwarzer,

[2]Raw data, analysis scripts, and output for all analyses are available online: https://osf.io/47efp/.

2008). Values for the I^2 statistic indicated moderate-to-high heterogeneity in each correlation across studies, and values for the Q-statistic indicated substantive heterogeneity in each model.

Bias estimates. As the confidence intervals of the correlations from the conventional meta-analysis did not encompass zero, the PEESE regression test was taken as an estimate of small study bias according to Stanley and Doucouliagos' (2014) rule. The test revealed substantive non-zero bias in the majority of the effects, with the exception of the attitude-past behavior, subjective norm-past behavior, perceived behavioral control-planning, and planning-behavior correlations (Table F1, Appendix F). However, the bias-corrected PEESE estimates did not alter conclusions with respect to whether effects were different from zero and their overall size.

Meta-Analytic Structural Equation Models

Proposed relations among the extended theory of planned behavior that included planning (Figure 1) and the original theory of planned behavior (Figure 2) structural equation models were tested by fitting the proposed model to the parameter estimates from the first stage of the meta-analytic structural equation modeling analysis. In addition, both models were estimated including and excluding past behavior as a predictor of all constructs in the model. Goodness-of-fit and overall homogeneity statistics for the models are presented in Table G1 (Appendix G, supplemental materials). All models exhibited acceptable model fit according to the multiple criteria adopted. Standardized parameter estimates and confidence intervals for the direct and indirect effects for the full and truncated models are presented in Tables 1 and 2[3], respectively, with test statistics comparing differences in parameters for the models that included and excluded past behavior.

Focusing on the extended theory of planned behavior, averaged parameter effects indicated that attitudes, subjective norms, and perceived behavioral control were non-zero predictors of parents' intention to engage in parent-for-child health behaviors, intention was a non-zero predictor of planning, and intention, perceived behavioral control, and planning were non-zero predictors of

[3]Full results of these analyses are available in Tables H1 and H2, Appendix H, supplemental materials.

behavior. Effect sizes ranged from small-to-medium to medium in size, with the largest effects for the attitude-intention and intention-planning effects. There were also non-zero indirect effects of attitudes, subjective norms, and perceived behavioral control on behavior through intention, and a non-zero indirect effect of intention on behavior through planning. Effect sizes for the indirect effects of attitudes, subjective norms, and planning were considered substantive[4]. Inclusion of past behavior resulted in the attenuation of many of the observed effects, consistent with observations elsewhere (Hagger, Chan, et al., 2016; Hagger et al., 2018); however, confidence intervals of the difference in the parameter estimates all encompassed zero, suggesting that the differences were not substantive.

Unsurprisingly, parameter estimates for the model testing the theory of planned behavior were consistent with those of the full model. There were non-zero effects of attitudes, subjective norms, and perceived behavioral control on parents' intention, and intention and perceived behavioral control on behavior, with small-to-medium effect sizes. There were also non-zero indirect effects of attitudes, subjective norms, and perceived behavioral control on behavior through intention, which were substantive in size. Again, inclusion of past behavior attenuated model effects, but only the effect of intentions on behavior, and the indirect effect of subjective norms on behavior through intentions, was different across models.

Moderator Analyses

The small number of studies testing effects of planning meant that there were empty cells for key relations between planning, past behavior, and other constructs in the model for some of the moderator groups. As a consequence, we used the model testing the theory of planned behavior excluding planning and past behavior (Figure 2) for all moderator analyses. Effects of moderators were tested by estimating the model in groups of studies defined by levels of the child age, sample type, measurement lag, behavior type, and study quality moderator variables. The models all

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[4]As standardized coefficients (β) for indirect effects are the product of multiple coefficients, standardized coefficients will by much smaller than those for direct effects. As a consequence, coefficients of .075 or larger were considered substantive while coefficients below this value were regarded trivial by comparison (Hagger, Koch, et al., 2017; Seaton, Marsh, & Craven, 2010).

exhibited adequate fit with the data based on multiple criteria (Table G1, Appendix G, supplemental materials). Standardized parameter estimates and comparisons across moderator groups are presented in Tables H3 to H11, (Appendix H, supplemental materials).

Moderator analyses revealed no differences in parameter estimates across moderator groups for the child age, sample type, and time lag moderators. For the behavior type moderator, the effect of subjective norms on parents' intention to perform parent-for-child health behaviors (β = .567, 95% CI [.300, .834]), and the indirect effect of subjective norms on behavior (β = .277, 95% CI [.152, .402]), were larger for the physical activity behaviors moderator group compared to protection or safety behaviors (direct effect, β = .270, 95% CI [168, .373]; indirect effect, β = .128, 95% CI [.062, .195]) and dietary behaviors (direct effect, β = .203, 95% CI [.031, .375]; indirect effect, β = .101, 95% CI [.005, 198]) groups. There were no differences for these parameters across the dietary and the protection or safety behavior groups. For the study quality moderator, the intention-behavior relationship was smaller, and the perceived behavioral control-intention relationship larger, in studies classified as acceptable in quality (intention-behavior, β = .385, 95% CI [.257, .514]; perceived behavioral control-intention, β = .261, 95% CI [.134, .388]) compared to those with questionable quality (intention-behavior, β = .615, 95% CI [.445, .785]; perceived behavioral control-intention, β = .092, 95% CI [-.095, .280]). The pattern of moderator effects was consistent regardless of the cut-off value used to distinguish between acceptable and questionable quality studies, although, in some cases, the standard difference test approached but did not exceed conventional criterion for statistical significance (Appendix H).

Discussion

The present study tested the determinants of parents' performance of behaviors to promote the health of their child, referred to as parent-for-child health behaviors, based on the theory of planned behavior. An extended model was also tested in which planning served as an additional predictor of behavior and mediated the intention-behavior relationship. In addition, tests of effects of salient moderators of theory effects, and whether model effects held when controlling for past behavior were conducted. Meta-analytic structural equation models supported the proposed pattern of effects among theory constructs, with attitudes, subjective norms, and perceived behavioral control predicting parents' intentions to perform health behaviors for their child, and intentions predicting behavior, all with small-to-medium sized effects. Effects of attitudes, subjective norms, and perceived behavioral control on the parent-for-child behaviors were mediated by intention, consistent with theory. In addition, planning independently predicted parent-for-child behaviors with a small effect size, and there was a non-trivial effect of planning on behavior mediated by intention. Model effects were attenuated but not extinguished with the inclusion of past behavior. Moderator analyses revealed few differences in effects across moderator groups, with the exception of the effect of subjective norms on intention and the indirect effect of subjective norms on behavior mediated by intention. These effects were larger for studies on parent-for-child physical activity behaviors compared to studies on dietary and protection or safety behaviors.

Current findings provide support for the key tenets of the theory of planned behavior for parent-for-child health behaviors. Results corroborate meta-analytic research applying the theory to predict individuals' performance of behaviors to promote their own health (McEachan et al., 2011; Rich et al., 2015). Across multiple studies, our findings indicate that parents' attitudes, subjective norms, and perceived behavioral control predicted their intention to perform parent-for-child health behaviors, and intention and perceived behavioral control predicted parents' behavior. The current research also implicated intention in the process by which beliefs relate to behavior; intention mediated the effect of attitudes, subjective norms, and perceived behavioral control on behavior. These findings extend the application of the theory to predict a unique set of health behaviors that are likely to have important effects on children's long-term health and the prevention of chronic disease. Findings indicate that the same set of social cognition constructs that predict performance of behaviors aimed at promoting personal health also predict parent-for-child behaviors.

Parents play an essential role in the socialization of children into healthy lifestyles (Maccoby, 1992), and their influence is integral to the promotion and modeling of health behaviors for their children (Keech, Hatzis, Kavanagh, White, & Hamilton, 2018). A key contribution of the current research is their potential to guide efforts to promote parents' participation in behaviors to promote their children's health by identifying modifiable constructs to target in behavioral interventions. The mediation effects suggest that targeting change in the determinants of intention may have a concomitant effect on behavior, consistent with recent experimental evidence (Sheeran et al., 2016). For example, attitudes could be changed through information provision, communication-persuasion, and cognitive dissonance techniques (e.g., Hamilton & Johnson, 2020; Keech, Cole, Hagger, & Hamilton, 2020), subjective norms changed using techniques such as establishing social norms and mobilizing social support (Borek et al., 2019; Norman et al., 2018); and perceived behavioral control through providing mastery and vicarious experiences (Sniehotta, 2009; Warner & French, 2020). In addition, current findings may also pave the way for research and interventions in other contexts in which decisions are made for others such as adult children performing support behaviors for their aging parents or caregivers providing support for relatives with long-term health conditions.

An important consideration when interpreting the effects in the current models is the practical significance of the small-to-medium effect sizes. The meta-analysis reflects aggregate effects of the social cognition and planning constructs on multiple behaviors across studies, so current results provide general guidance on the expected size of the relationship between a measure of a model construct and a parent-for-child behavior in any given study. As an illustration, consider the small-to-medium sized effect of intentions on behavior (standardized effect, $\beta = .329$); this suggests that a unit variation in intentions should be met by a third of a unit variation in behavior. This level of change is consistent with the effect sizes observed in syntheses of intervention research targeting change in intentions (Webb & Sheeran, 2006) and theory of planned behavior constructs (Sheeran et al., 2016). In addition, interventions based on the theory of planned behavior have demonstrated similar-sized effects on parent-for-child intentions and behavior (Abhyankar et al., 2008; Hatefnia, Alinasab, & Ghorbani, 2017), and such effects relate to meaningful numbers of individuals exhibiting change in the targeted behaviors (e.g., numbers of mothers intending to vaccinate their child). However, it should be stressed that current data are based on correlational evidence, which should not be taken as analogous to causal evidence from interventions or experimental research. So, the effects identified in the current study should only be considered indicative of the level of the model constructs and behavior relative to each other, rather than direct guidance for intervention or expected meaningful intervention effects.

Current findings also indicate that planning mediates the intention-behavior relationship, consistent with dual phase models such as the health action process approach (Schwarzer, 2008; Schwarzer & Hamilton, 2020; Zhang et al., 2019). This suggests that self-regulatory skills such as action plans are potential means by which parents overcome obstacles that inhibit acting on their intention to perform parent-for-child health behaviors. Planning, then, should be considered an important component of interventions aimed at promoting parent-for-child health behaviors. Such interventions might entail prompting parents to identify appropriate environmental cues and link them with the intended behavior to promote the health of their child, such as action plans (Schwarzer, 2008) or ‘implementation intention’ (Gollwitzer, 1999).

A further important finding in the current research was the relatively small number of moderator effects found on the relations between constructs in the proposed model for parent-for-child health behaviors. Specifically, model effects were found to be consistent across demographic (age of child, sample type), methodological (time lag between measures of theory constructs and behavior), and conceptual (behavior type) moderators. The lack of moderator effects reflects that the observed variability in model effects for parent-for-child behaviors was not attributable to this set of moderators, and perhaps other moderator variables not coded for in the current analysis were responsible for the effect. Conversely, it may be that there was insufficient range in the coded moderators to account for variation across studies. For example, many of the studies did not provide long-range prediction of behaviors – the vast majority included a follow-up of fewer than five weeks which limited evaluation as to whether model effects varied by time lag between measures.

The only moderator effects identified were those for behavior type and study quality. For the behavior type moderator analysis, larger direct effects of subjective norms on intention, and indirect effects of subjective norms on behavior through intention, were observed in studies on physical activity relative to studies on dietary and protection or safety behaviors. This suggests that beliefs reflecting perceived social pressure or support to perform the behavior may be more important when it comes to parents supporting or promoting physical activity behaviors for their child. To speculate, social pressure and support may be more salient when it comes to performing of behaviors that require greater social involvement. Physical activity behaviors often require the parent to become personally involved, such as parents directly participating in physical activities with their children, like playing games in the backyard, or watching or co-acting in activities with their children, such as taking their children to the swimming pool or to dance lessons. Social influences may be more pervasive for these behaviors compared to protection or safety behaviors (sunscreen, vaccination) and dietary behaviors (cooking meals), which often involve the parent directly performing the behavior for the child.

For the study quality moderator analysis, the intention-behavior relationship was smaller in studies of acceptable quality relative to those with questionable quality. There was also a trend toward a larger perceived behavioral control-behavior effects in studies with questionable quality compared to those with acceptable quality. Studies with lower quality may lead to imprecision in effect size estimates. The additional error variance associated with imprecisions in study design may lead to an attenuation or inflation of relations (Johnson, Low, & MacDonald, 2014). While these differences did not lead to an invalidation of the model because effects were non-zero in both moderator groups, it highlights the potential consequences of imprecision in study methods on estimation of effects. This suggests that researchers conducting predictive studies in this domain could potentially minimize bias in model results by accounting for study quality features at the inception and design phases.

A final notable finding in the current research is that although past behavior predicted all constructs and attenuated the size of the intention-behavior relationship, the pattern of effects in the model remained unchanged. The attenuation of model effects by past behavior has been observed in many other applications of the theory of planned behavior (e.g., Albarracín, Johnson, Fishbein, & Muellerleile, 2001; Chatzisarantis, Hagger, Smith, & Phoenix, 2004; Hagger, Chan, et al., 2016). Its inclusion is important because it provides a test of the sufficiency of the theory (Ajzen, 1991). A sufficient theory needs to account for unique variance in behavior and mediate effects of past behavior on subsequent behavior. If it does not, it is insufficient as a means to explain behavioral consistency. Current findings confirmed that past behavior effects on subsequent behavior were partially mediated by the social cognition constructs from the theory, providing support for theory sufficiency in the context of parent-for-child health behaviors. Mediation of past behavior effects by the belief-based constructs from the theory are proposed to represent previous decision making and individuals formation of beliefs on the basis of previous experience (Ajzen, 2002; Hagger, Chan, et al., 2016).

However, substantive residual effects of past behavior on subsequently-measured behavior were also observed in the current analysis, consistent with previous research (Hagger, Chan, et al., 2016; Hagger et al., 2018). Numerous explanations have been put forward to explain these residual effects. For example, past behavior is suggested to serve as a ‘proxy’ for habits, or reflect effects of unmeasured behavioral determinants. Better understanding of the processes reflected by past behavior effects necessitates identification of potential mediators of the residual effects. One candidate mediator is a measure of habit; research has demonstrated that self-reported habit mediates past behavior effects on behavior within the theory of planned behavior supporting the proposition that past behavior, at least in part, reflects habits (Hamilton, Gibbs, Keech, & Hagger, 2020; van Bree et al., 2015). In addition, residual effects of past behavior unmediated by intention may reflect effects of non-conscious determinants or individual difference factors on behavior, such as implicit attitudes, and personality (Conner & Abraham, 2001; Hagger, Trost, Keech, Chan, & Hamilton, 2017; Hamilton et al., 2020; Vo & Bogg, 2015). Future research should seek to establish whether residual effects of past behavior for parent-for-child health behaviors are mediated by habit or constructs representing non-conscious processes.

Strengths, Limitations, and Avenues for Future Research

Strengths of the current research include the focus on the determinants of parents' behaviors to promote their children's health, an important and unique behavioral context; an appropriate theoretical approach; wide coverage of research in across multiple health behaviors (e.g., physical activity, protection or safety, and dietary behaviors); use of appropriate synthesis and analytic techniques to test theory predictions across studies; and a robust test of candidate moderators on model effects. However, a number of limitations should be highlighted. High heterogeneity was observed in the parameter estimates of the models across studies, and current moderator analyses did not resolve the heterogeneity, suggesting the likely presence of moderators, but analyses of current moderators did not resolve the extent heterogeneity. One of the limitations of the current research is that we unable to test effects of theory-based moderators of model effects. For example, planning may moderate the effect of parents' intention on their performance of health promoting behavior for their children, consistent with previous research in other behavioral domains (e.g., de Bruijn, Rhodes, & van Osch, 2012). However, there were insufficient studies testing this effect precluding a test of this moderation hypothesis. Furthermore, the protection or safety behaviors moderator variable comprised multiple behaviors aimed at reducing health risk to the child such as vaccination, use of car seats, providing medication, sunscreen use, supervised tooth brushing, and injury prevention practices. The wide range of health behaviors included in this moderator variable likely contributed to the high variability observed within the moderator groups. The ongoing expansion of the research literature in this domain may permit a more fine-grained moderator analysis of specific protection or safety behaviors in future, which may be instrumental to resolving the variability.

Another limitation was that all data in the current sample of studies were correlational in design, so reported effects reflect prediction rather than change and causal effects in the models are inferred from theory alone not the data. Future research adopting cross-lagged panel, experimental, or intervention designs is required in order to make better inferences of change and causation. Linked to this, current analysis is limited due to the exclusive reliance on self-report measures of behavior. Such measures present an increased risk of bias and, therefore, potential for introducing method error to reported effects, attributable to recall bias and socially desirable responding. There is considerable need for studies in this domain to conduct research that verifies model effects without reliance on self-report behavioral measures.

In addition, that our moderator analyses did not resolve the heterogeneity in effects across studies suggests the presence of other moderators. Furthermore, we did not include pertinent control variables in our model test such as parent age and resource availability (e.g., access to childcare, financial and social support). Limitations in data availability and reporting precluded such analyses. For example, parental age was highly variable within and across studies, limiting coding of a meaningful parental age moderator variable, and few studies measured or reported relations between variables relating to resources, such as childcare access, and study constructs. As the literature on social cognition determinants of parent-for-child behaviors expands, future syntheses may have access to sufficient data to examine the moderating effects of these variables on relations between model variables or control for their effects.

Finally, the theory of planned behavior was only extended to include planning as an additional construct. Other constructs have been shown to be important predictors of parent-for-child health behaviors such as role construction, moral norms, anticipated affect, and action control (Hamilton et al., 2018; Hamilton, Kirkpatrick, Rebar, White, & Hagger, 2017; Hamilton, Peden, Smith, & Hagger, 2019; Schmidt & Hamilton, 2017). Furthermore, the theory does not provide a clear account for health behaviors that have a social or dyadic component (Scholz, Berli, Lüscher, & Knoll, 2020), nor does it explicitly account for effects of socio-demographic variables such as education, income, or other indices of socio-economic status (Schüz, 2017). Such variables have become important topics in research extending the theory of planned behavior, and may be important considerations that need to be accounted for in future research applying this theory to parent-for-child behaviors. As the research in this area expands, future research syntheses may be able to include a wider range of potentially important determinants toward a more comprehensive and precise model of parent-for-child behaviors.

Conclusion

Current findings provide the first synthesis of the determinants of parent-for-child health behaviors on the theory of planned behavior. The current analysis makes a unique contribution to knowledge by identifying the extent to which theory-based constructs determine parent-for-child health behaviors across multiple studies. The study also extended the theory to include planning and past behavior as additional determinants, and tested effects of candidate moderators on theory relationships. Findings provide support for the predictions of the theory of planned behavior, identifying attitudes, subjective norms, and perceived behavioral control as predictors of parents' intention to perform health-promoting behaviors for their children, and intention, planning, perceived behavioral control, and past behavior as predictors of actual behavior. The model also provides some indication of the processes by which these constructs relate to behavior, with intention mediating effects of beliefs and past behavior on behavior, and planning mediating the intention-behavior relationship. This knowledge provides valuable formative evidence of potential targets in behavior change interventions aimed at promoting parents' behaviors to promote their children's health. Study findings also set the agenda for future research to address gaps in knowledge in the application of the theory of planned behavior to parent-for-child health behaviors.

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Table 1

Standardized Path Coefficients for Direct and Indirect Effects for the Meta-Analytic Structural Equation Model (Stage 2) of the Theory of Planned Behavior with Planning Excluding and Including Past Behavior with Model Comparisons

Effect	Model excluding past behavior			Model including past behavior			Model comparisons[a]		
	β	Wald CI_{95}		β	Wald CI_{95}		$β_{diff}$	CI_{95}	
		LL	UL		LL	UL		LL	UL
Direct effects									
Intention→Behavior	.329	.160	.497	.240	.049	.430	.089	-.165	.343
PBC→Behavior	.150	.035	.265	.094	-.033	.221	.056	-.115	.227
Planning→Behavior	.255	.099	.411	.098	-.147	.342	.158	-.132	.447
Attitude→Intention	.369	.260	.477	.301	.175	.428	.067	-.099	.234
PBC→Intention	.202	.100	.304	.172	.055	.288	.031	-.124	.186
SN→Intention	.239	.127	.352	.187	.055	.320	.052	-.122	.226
Intention→Planning	.477	.317	.637	.309	.074	.544	.168	-.116	.452
PB→Attitude	–	–	–	.344	.219	.469	–	–	–
PB→Behavior	–	–	–	.392	.210	.573	–	–	–
PB→Intention	–	–	–	.214	.023	.404	–	–	–
PB→PBC	–	–	–	.359	.248	.471	–	–	–
PB→Planning	–	–	–	.431	.163	.699	–	–	–
PB→SN	–	–	–	.393	.266	.519	–	–	–
Indirect effects									
Attitude→Intention→Behavior	.121	.056	.186	.072	.007	.137	.049	-.043	.141
SN→Intention→Behavior	.079	.019	.139	.045	-.009	.098	.034	-.047	.114
PBC→Intention→Behavior	.066	.019	.114	.041	-.003	.086	.025	-.040	.090
Intention→Planning→Behavior	.122	.043	.200	.030	-.047	.108	.092	-.019	.202
Correlations									
Attitude↔PBC	.337	.275	.400	.211	.124	.298	.126	.019	.233
SN↔PBC	.326	.267	.385	.180	.092	.269	.145	.039	.252
PBC↔Planning	.176	.020	.331	.106	-.051	.264	.070	-.152	.291
SN↔Planning	.234	.048	.421	.111	-.114	.335	.124	-.168	.416
Attitude↔SN	.423	.355	.491	.286	.191	.381	.136	.019	.254

Note. β = Standardized path coefficient; Wald CI_{95} = Wald 95% confidence interval; LL = Lower limit of CI_{95}; UL = Upper limit of CI_{95}; CI_{95} = Conventional 95% confidence interval; $β_{diff}$ = Difference in standardized path coefficient; SN = Subjective norms; PBC = Perceived behavioral control; PB = Past behavior; [a]Model comparisons made using Schenker and Gentleman's (2001) 'standard method' using confidence intervals about the mean difference; [b]Sum of indirect effects of past behavior on behavior; [c]Total effect of past behavior on behavior.

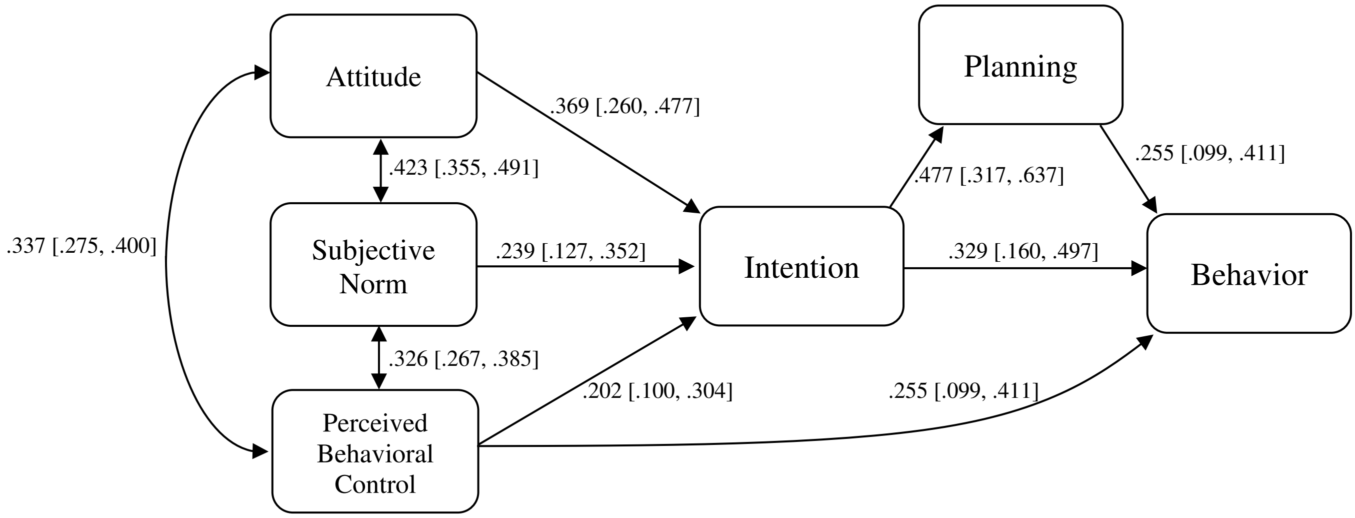
Table 2

Standardized Path Coefficients for Direct and Indirect Effects for the Meta-Analytic Structural Equation Model (Stage 2) of the Theory of Planned Behavior Excluding and Including Past Behavior with Model Comparisons

Effect	Model excluding past behavior			Model including past behavior			Model comparisons[a]		
	β	Wald CI_{95}		β	Wald CI_{95}		$β_{diff}$	CI_{95}	
		LL	UL		LL	UL		LL	UL
Direct effects									
Intention→Behavior	.482	.370	.594	.277	.117	.437	.205	.010	.401
PBC→Behavior	.188	.078	.298	.106	-.023	.235	.082	-.088	.252
Attitude→Intention	.319	.211	.427	.296	.171	.420	.024	-.141	.189
PBC→Intention	.198	.099	.298	.169	.052	.285	.030	-.124	.183
SN→Intention	.285	.184	.385	.186	.052	.320	.099	-.069	.266
PB→Attitude	–	–	–	.317	.191	.442	–	–	–
PB→Behavior	–	–	–	.433	.292	.573	–	–	–
PB→Intention	–	–	–	.230	.042	.418	–	–	–
PB→PBC	–	–	–	.354	.242	.467	–	–	–
PB→SN	–	–	–	.398	.275	.520	–	–	–
Indirect effects									
Attitude→Intention→Behavior	.154	.095	.213	.082	.023	.141	.072	-.011	.156
SN→Intention→Behavior	.137	.079	.196	.051	-.001	.104	.086	.007	.165
PBC→Intention→Behavior	.096	.039	.152	.047	.004	.089	.049	-.022	.119
Correlations									
Attitude↔PBC	.336	.274	.398	.223	.137	.309	.113	.007	.219
SN↔PBC	.328	.269	.388	.181	.092	.270	.147	.040	.254
Attitude↔SN	.422	.353	.490	.295	.200	.390	.126	.009	.243

Note. β = Standardized path coefficient; Wald CI_{95} = Wald 95% confidence interval; LL = Lower limit of CI_{95}; UL = Upper limit of CI_{95}; CI_{95} = Conventional 95% confidence interval; $β_{diff}$ = Difference in standardized path coefficient; SN = Subjective norms; PBC = Perceived behavioral control; PB = Past behavior; [a]Model comparisons made using Schenker and Gentleman's (2001) 'standard method' using confidence intervals about the mean difference; [b]Sum of indirect effects of past behavior on behavior; [c]Total effect of past behavior on behavior.

Figure 1. Model of the theory of planned behavior augmented to include planning excluding (upper diagram) and including (lower diagram) past behavior.



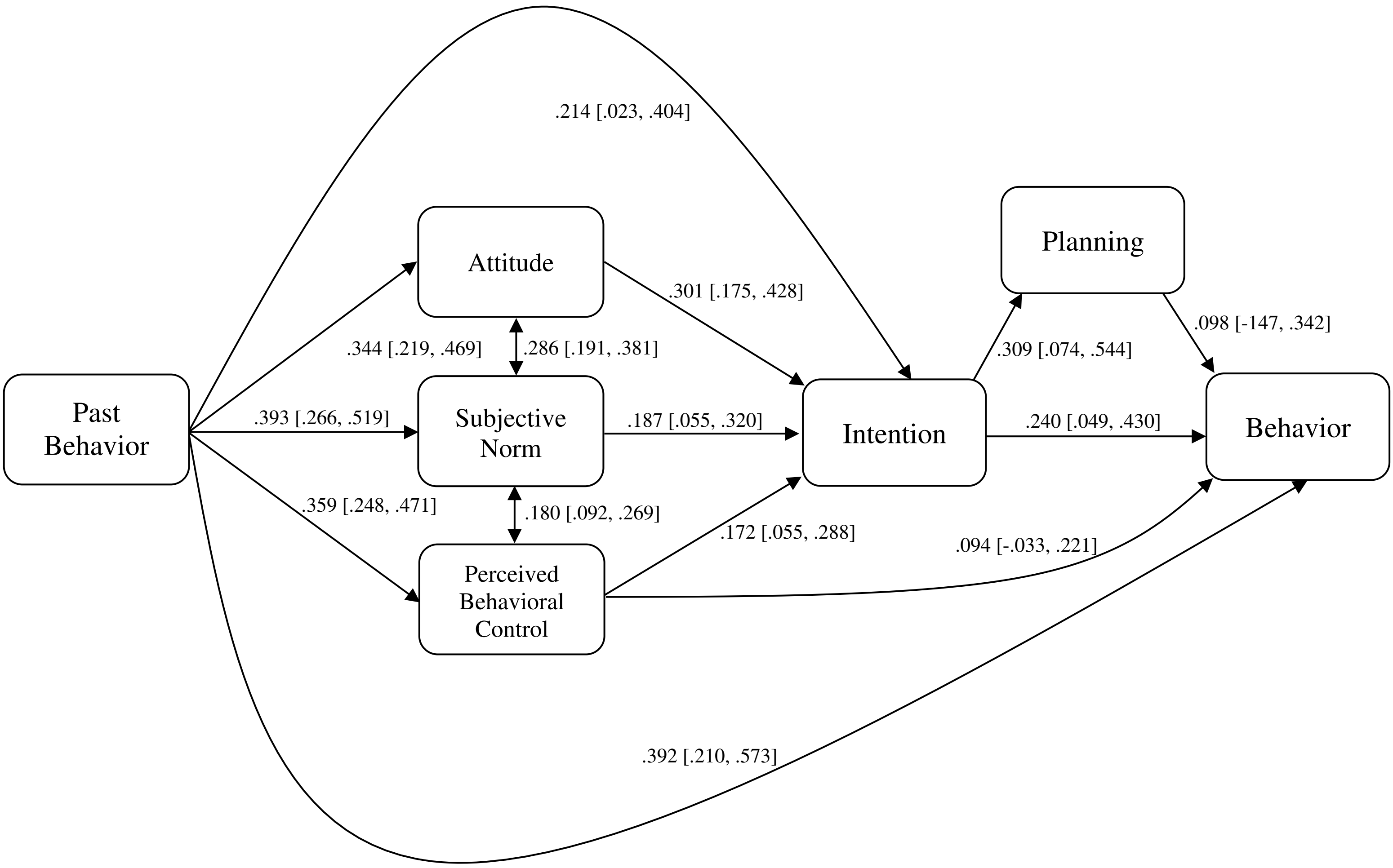
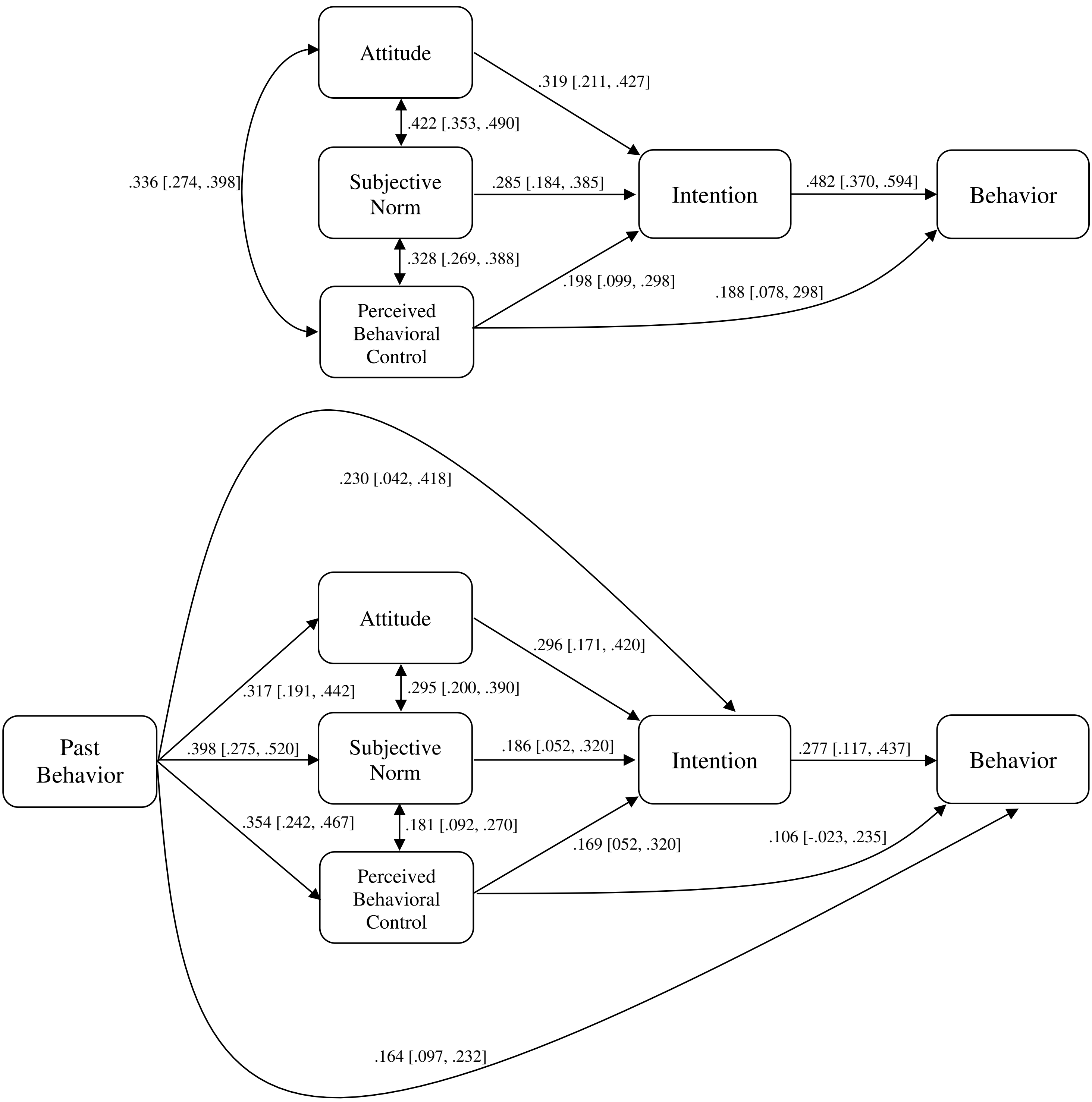
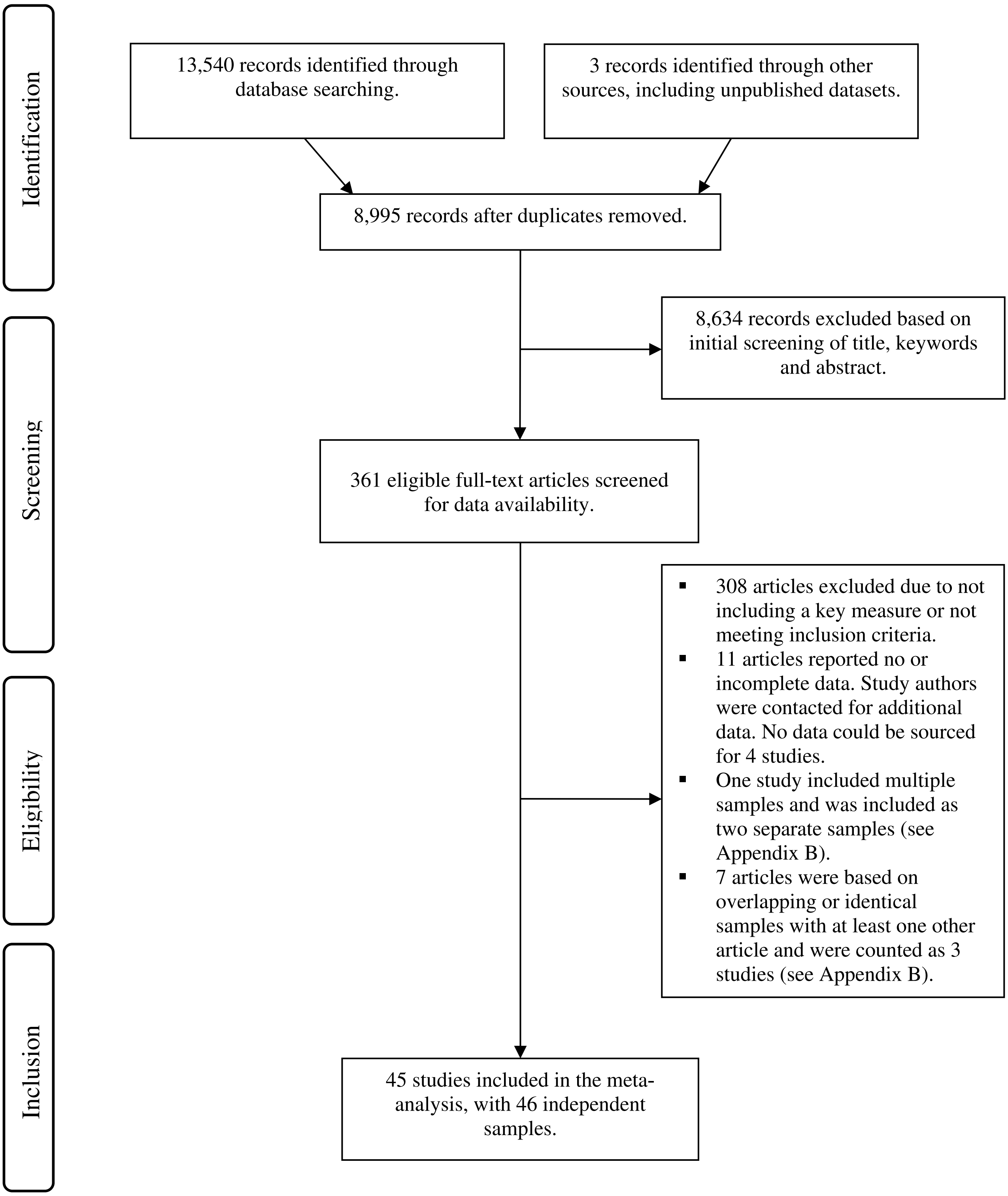


Figure 2. Model of the theory of planned behavior excluding (upper diagram) and including (lower diagram) effects of past behavior.



Appendix A: PRISMA flow diagram for study search and inclusion strategy



Appendix B: Multiple and overlapping studies

Table B1

Studies Included in Meta-Analysis with Multiple Studies/Samples/Behaviors

Reference	Samples[a]	Behaviors[b]	Treatment[c]
1. de Vries et al. (2012)	2	1 (sunscreen use)	Separate effect sizes
2. Hamilton et al. (2013)	1	2 (screen time & PA)	Aggregated[d]
3. Ice et al. (2014)	1	3 (fruit & vegetable intake, moderate PA, vigorous PA)	Aggregated[d]
4. Spinks & Hamilton (2016)	1	2 (Healthy eating; Discretionary choices)	Aggregated[d]
5. Swanson et al. (2011)	1	3 (Eating breakfast; Cooking meals; Sit down meals)	Aggregated[d]
6. Tickner et al. (2010)	1	2 (Receiving MMR vaccine; Receiving the dTaP/IPV vaccine)	Aggregated[d]
7. Van den Branden et al. (2012, 2013, 2015)	1	3 (Visit dentist; Oral hygeine; Diet habits)	Aggregated[d]

Note. [a]Number of independent samples reported in study; [b]Number behavioral outcomes reported within each sample; [c]How samples were treated in the meta-analysis; [d]Effect sizes aggregated across behaviors within each sample using Hunter and Schmidt's (2004) formula for aggregating dependent correlations with the correlation for the within-study effect sizes set at .50 (Wampold et al., 1997). PA = Physical activity.

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Van den Branden, S., Van den Broucke, S., Leroy, R., Declerck, D., & Hoppenbrouwers, K. (2013). Measuring determinants of oral health behaviour in parents of preschool children. *Community Dental Health, 30*, 19-25. https://doi.org/10.1922/CDH_2897Branden07

Van den Branden, S., Van den Broucke, S., Leroy, R., Declerck, D., & Hoppenbrouwers, K. (2015). Predicting oral health-related behaviour in the parents of preschool children: An application of the theory of planned behaviour. *Health Education Journal, 74*, 221-230. https://doi.org/10.1177/0017896914530585

Wampold, B. E., Mondin, G. W., Moody, M., Stich, F., Benson, K., & Ahn, H.-N. (1997). A meta-analysis of outcome studies comparing bona fide psychotherapies: Empiricially, "all must have prizes." *Psychological Bulletin, 122*, 203-215. https://doi.org/10.1037/0033-2909.122.3.203

Table B2
Studies Included in Meta-Analysis with Overlapping Samples

Studies	Group name[a]
1. Hamilton, K., Kirkpatrick, A., Rebar, A., & Hagger, M. S. (2017). Child sun safety: Application of an integrated behavior change model. *Health Psychology, 36*, 916-926. doi: 10.1037/hea0000533 2. Hamilton, K., Kirkpatrick, A., Rebar, A., White, K. M., & Hagger, M. S. (2017). Protecting young children against skin cancer: Parental beliefs, roles, and regret. *Psycho-Oncology, 26*, 2135–2141. doi: 10.1002/pon.4434	Hamilton et al. (2017a); Hamilton et al. (2017b)
3. Johnson, L., Chen, T.-A., Hughes, S. O., & O'Connor, T. M. (2015). The association of parent's outcome expectations for child TV viewing with parenting practices and child TV viewing: An examination using path analysis. *International Journal of Behavioral Nutrition and Physical Activity, 12*, 70. doi: 10.1186/s12966-015-0232-2 4. O'Connor, T. M., Chen, T.-A., del Rio Rodriguez, B., & Hughes, S. O. (2014). Psychometric validity of the parent's outcome expectations for children's television viewing (POETV) scale. *BMC Public Health, 14*, 894. doi: 10.1186/1471-2458-14-894	Johnson, Chen, Hughes, & O'Connor (2015); O'Connor, Chen, del Rio Rodriguez, & Hughes (2014)
5. Van den Branden, S., Van den Broucke, S., Leroy, R., Declerck, D., & Hoppenbrouwers, K. (2012). Effects of time and socio-economic status on the determinants of oral health-related behaviours of parents of preschool children. *European Journal of Oral Sciences, 120*, 153-160. doi: 10.1111/j.1600-0722.2012.00951.x 6. Van den Branden, S., Van den Broucke, S., Leroy, R., Declerck, D., & Hoppenbrouwers, K. (2013). Measuring determinants of oral health behaviour in parents of preschool children. *Community Dental Health, 30*, 19-25. doi: 10.1922/CDH_2897Branden07 7. Van den Branden, S., Van den Broucke, S., Leroy, R., Declerck, D., & Hoppenbrouwers, K. (2015). Predicting oral health-related behaviour in the parents of preschool children: An application of the theory of planned behaviour. *Health Education Journal, 74*, 221-230. doi: 10.1177/0017896914530585	van den Branden et al. (2012, 2013, 2015)

Note. [a]Summary name used to refer to the group of overlapping studies in the study characteristics table presented in Appendix C.

Appendix C: Summary Characteristics

Table C1

Summary Characteristics and Moderator Coding of Studies Included in Meta-Analysis

Study	Year	N	Child age[a]	Child gender (% female)	Parent/ caregiver age[a]	Parent/care-giver gender (% female)	Constructs measured	Moderator coding						
								Behavior[b]	Sample type[d]	Child age	Time lag[e]	Study quality[f]		
												65%	70%	75%
Abhyankar, O'Connor & Lawton	2008	142	–	–	*M* = 35.23, *SD* = 10.03, range 17-66	100	PB, INT, MSE, AP, CP	PRO	MFC	–	NA	QUE		
Abizari, Pilime, Armar-Klemesu & Brouwer	2013	120	6-7 = 34 (28.3%); 8-9 = 42 (35.0%); 10-11 = 41 (34.2%); ≥ 12 = 3 (2.5%); range = 6-12	42.5	19-34 = 54 (45.0%); 35-49 = 36 (30.0%); >49 = 30 (25.0%)	87.5	PB, RP, OE, ASE, INT, AP, CP, MSE, RSE, AC	DIE	PCG	OLD	NA	ACC		
Askelson, Campo, Smith, Lowe, Dennis, & Andsager	2011	217	*M* = 11.21, *SD* = 1.82; range = 9-15	100	NA	100	RP, OE, ASE, INT, AP, MSE	PRO	MFC	OLD	NA	ACC		
ÅstrØm & Kiwanuka	2006	615	*M* = 4.33; range = 3-5	48.94	*M* = 32.50; *SD* = 7.80, range = 16-72	64	PB, ASE, INT, MSE, RSE, AP, AC	DIE	PCG	YNG	NA	ACC		
Bai, Dinour, & Pope	2016	218	–	–	*M* = 31.63, *SD* = 8.67, range = 42	100	RP, OE, ASE, INT, AP AC	DIE	MFC	–	NA	ACC		
Bos, Hoogstraten, & Prahl-Andersen	2005	157	–	–	Female *M* = 41.6, *SD* 6.34; Male *M* = 45.68, *SD* = 6.23	73.25	PB, RP, OE, ASE, INT, AP	MSC	PCG	–	NA	QUE		
Bracchitta	2006	151	Range = 4-8	50.3	*M* = 37.9; *SD* = 5.1, range = 23-52	83.4	ASE, INT, MSE, RSE, AP	PRO	MFC	OLD	NA	QUE		
Charron-Prochownik, Becker, Brown, Liang, & Bennett	1993	50	*M* = 7.8, *SD* = 1.1, range = 6-9	44	NA	–	PB, OE, ASE, INT, MSE, AP, CP	PRO	–	OLD	NA	ACC		
de Vries, van Osch, Eijmael, Smerecnik, & Candel Study 1	2012	391	*M* = 14 months; *SD* = 5.9 months; range = 0-2 years	–	*M* = 33.2; *SD* = 3.7	92.8	RP, OE, ASE, INT, MSE, AP, CP	PRO	PCG	YNG	LNG	ACC		
de Vries, van Osch, Eijmael, Smerecnik, & Candel Study 2	2012	495	Range = 6-9	–	*M* = 36.4, *SD* = 5.2	77.1	PB, RP, OE, ASE, INT,	PRO	PCG	OLD	LNG	ACC		

							MSE, AP, CP, AC					
Fahy & Desmond	2010	72	Range = 8-16	100	*M* = 41.56, *SD* = 5.82, range = 29-53	100	PB, RP, OE, ASE, INT, MSE, RSE, AP, CP	PRO	MFC	OLD	NA	QUE
Goodnight et al.	2014	99	Range = 10-14	52.53	Control *M* = 40.71, *SD* = 8.72; Intervention *M* = 44.16, *SD* = 13.84	100	PB, RP, OE, ASE, INT, MSE, RSE, AP	PRO	MFC	OLD	NA	QUE
Hamilton, Spinks et al.	2016	207	Range = 2-5	–	Mothers *M* = 36.43, *SD* = 5.04; Fathers *M* = 36.33, *SD* = 6.5	66.7	RP, OE, ASE, INT, AP	PA	PCG	YNG	SRT	QUE
Hamilton et al. (2017a); Hamilton et al. (2017b)	2017	273	Range = 2-5	–	T1 *M* = 35.09 *SD* = 5.39; T2 *M* = 34.80, *SD* = 5.21	87.2	PB, RP, OE, ASE, INT, MSE, RSE, AP	PRO	PCG	YNG	SRT	ACC
Hamilton & Schwarzer	2018	208	Female = 3.87, *SD* = .96. Male *M* = 3.87, *SD* = 1.02. Range 2 - 5	47.1	Mother *M* = 36.43, *SD* = 5.04, Fathers *M* = 36.33, *SD* = 6.5	66.8	RP, OE, ASE, INT, AP, CP	PA	PCG	YNG	SRT	ACC
Hamilton, Cornish, Kirkpatrick, Kroon, & Schwarzer	2018	281	Range = 2-5	–	NA	70.1	RP, OE, ASE, INT, AP	PRO	PCG	YNG	SRT	ACC
Hamilton, Thompson, & White (physical activity)	2013	162	Range = 4-5	–	*M* = 35.19, *SD* = 5.39; range = 17-49	100	PB, OE, ASE, INT, AP	PA	MFC	YNG	SRT	QUE
Hamilton, Thompson, & White (screen time)	2013	162	Range = 4-5	–	*M* = 35.19, *SD* = 5.39; range = 17-49	100	PB, OE, ASE, INT, AP	PA	MFC	YNG	SRT	QUE
Hamilton, Daniels, White, Murray, & Walsh	2011	375	*M* = 13 weeks, *SD* = 3 weeks	–	*M* = 29.2, *SD* = 5.5	100	PB, RP, OE, ASE, INT, AP, AC	DIE	MFC	YNG	LNG	ACC
Hatefnia, Alimasab, & Ghorbani	2017	80	Range = 3-6	–	18 - 49	100	PB, RP, OE, ASE, INT, AP, AC	PRO	MFC	YNG	NA	QUE
Hofman, Empelen, Richardus, Kok, Koning, Ballegooijen, & Korfage	2014	1725	Range = 10-11	100	*M* = 42.8, *SD* = 4.17	93.7	ASE, INT, AP, CP, AC	PRO	PCG	OLD	NA	ACC
Hounsa, Godin, Alihonou, Valois, & Girard	1993	128	>1 year old	–	*M* = 29.24, *SD* = 6.17	100	PB, RP, ASE, INT, AP, CP	DIE	MFC	YNG	NA	QUE
Ice, Neal, & Cottrell (fruit and vegetable intake)	2014	444	NA	50.5	NA	92	PB, OE, ASE, INT, AP, CP	DIE	PCG	–	NA	QUE
Ice, Neal, & Cottrell (moderate physical activity)	2014	516	NA	50.5	NA	92	RP, OE, ASE, INT, MSE, AP, CP	PA	PCG	–	NA	QUE

Ice, Neal, & Cottrell (vigorous physical activity)	2014	516	NA	50.5	NA	92	PB, OE, ASE, INT, CP	PA	PCG	–	NA	QUE
Janicke & Finney	2003	87	*M* = 6.8, *SD* = 1.4, Range = 4-9	40.2	*M* = 38.4, *SD* = 5.5, Range = 26 - 50	94.3	PB, ASE, INT, CP	MSC	PCG	OLD	NA	QUE
Johnson, Chen, Hughes, & O'Connor (2015); O'Connor, Chen, del Rio Rodriguez, & Hughes (2014)	2015	311	*M* = 9.14, *SD* = 2.42; Range = 6-12	41.81	*M* = 37.54, *SD* = 8.39	94.21	PB, ASE, INT, CP	PA	PCG	OLD	NA	ACC
Kafulafula, Hutchinson, Gennaro, Guttmacher, & Kumitawa	2013	110	Infants of breastfeeding age	–	>18 years	100	PB, RP, OE, ASE, INT, AP, CP	DIE	MFC	YNG	LNG	ACC
Lampard, Jurkowski, & Davison	2013	146	*M* = 3.7, *SD* = 0.9; range = 2-6	55.4	*M* = 30.7, *SD* = 9.5	93.1	PB, RP, OE, ASE, INT, MSE, RSE, AP, CP	PA	PCG	YNG	NA	ACC
Lee & Kam	2015	7620	Range = 9-18	–	NA	–	RP, OE, ASE, INT, MSE, AP	PRO	–	OLD	LNG	QUE
Lwin & Saw	2007	401	NA	50		–	PB, OE, INT, RSE, AP	MSC	PCG	–	NA	QUE
Manstead, Pelvin, & Smart	1984	50	Infants in-utero for at least 28 weeks	–	Range = 16 - 38	100	PB, OE, INT, RSE, AP	DIE	MFC	YNG	LNG	QUE
Manstead, Proffitt, & Smart	1983	300	Infants in-utero for at least 28 weeks	–	*M* = 26.3, Range = 16 - 40	100	PB, RP, OE, ASE, INT, MSE, RSE, AP	DIE	MFC	YNG	LNG	QUE
McDonald, Cunningham, & Slavin	2015	446	NA	–	16-25 = 121; 26-55 = 267; > 56 = 55	74.66	PB, RP, ASE, INT, AP	PRO	PCG	–	NA	QUE
Norman, Searle, Harrad, & Vedhara	2003	151	*M* = 4.45, Range = 1-8	48	NA	85	PB, RP, ASE, INT, AP	MSC	PCG	YNG	LNG	QUE
Poorolajal, Cheraghi, Hazavehei, Rezapur-Shahkolai	2013	580	Under 5 years old	51.72	NA	100	PB, ASE, INT, AP	PRO	MFC	YNG	NA	QUE
Rhodes, Berry, Craig, Faulkner, Latimer-Cheung, Spence, & Tremblay	2013	663	Range = 5 - 11 year olds	–	NA	100	OE, ASE, INT, MSE, AP, CP	PA	MFC	OLD	NA	ACC
Rhodes, Spence, Berry, Deshpande, Faulkner, Latimer-Cheung, O'Reilly, & Tremblay	2016	1253	*M* = 7.11, *SD* = 3.96, Range = 5-12	48.6	NA	100	OE, ASE, INT, MSE, AP, CP	PA	MFC	OLD	LNG	ACC
Russell	1991	50	Range = 1-3	–	*M* = 23, range = 17-36	100	PB, ASE, INT, MSE, AP, CP	PRO	MFC	YNG	NA	QUE
Schuster, Kubacki, & Rundle-Thiele	2016	512	Range = 5 - 12	48.2	NA	87.8	PB, ASE, INT, MSE, AP, CP	PA	PCG	OLD	NA	QUE
Spinks & Hamilton (healthy eating)	2016	197	Range = 2-3	–	*M* = 34.39, *SD* = 5.65; range = 18-46	100	PB, RP, OE, ASE, INT, MSE, AP	DIE	MFC	YNG	SRT	QUE
Spinks & Hamilton (discretionary choices)	2016	197	Range = 2-3	–	*M* = 34.39, *SD* = 5.65; range = 18-46	100	PB, RP, OE, INT, RSE, AP	DIE	MFC	YNG	SRT	QUE

Swanson et al. (eating breakfast)	2011	300	*M* = 30.3 months, *SD* = 3.2 months, Range 24 - 36 months	49	*M* = 24.9, *SD* = 3.2; range = 18-34	100	PB, RP, OE, ASE, INT, AP	DIE	MFC	YNG	NA	QUE
Swanson et al. (cooking meals)	2011	300	*M* = 30.3 months, *SD* = 3.2 months, Range 24 - 36 months	49	*M* = 24.9, *SD* = 3.2; range = 18-34	100	RP, OE, ASE, INT, MSE, AP	DIE	MFC	YNG	NA	QUE
Swanson et al. (sit-down meals)	2011	300	*M* = 30.3 months, *SD* = 3.2 months, Range 24 - 36 months	49	*M* = 24.9, *SD* = 3.2; range = 18-34	100	PB, INT, RSE, AP	DIE	MFC	YNG	NA	QUE
Talsma et al.	2013	140	Range = 6-12	–	NA	96	PB, RP, OE, ASE, INT, MSE, RSE, AP	DIE	PCG	OLD	NA	QUE
Thompson, White, & Hamilton	2012	162	range = 4-5	–	*M* = 35.19, *SD* = 5.39; range = 17-49	100	PB, RP, OE, ASE, INT, MSE, RSE, AP	PRO	MFC	YNG	SRT	ACC
Tickner, Leman, & Woodcock	2010	147	*M* = 2.71, *SD* = .75; range = 1-4	48.3	NA	97.93	PB, ASE, INT, AP	PRO	PCG	YNG	NA	ACC
Tickner, Leman, & Woodcock	2010	108	*M* = 2.72, *SD* = .76; range = 1-4	46.3	NA	92.45	PB, INT, MSE, AP	PRO	PCG	YNG	NA	ACC
van den Branden et al. (2012, 2013, 2015) (visit dentist)	2012	1325	*M* = 5.3 years-old, *SD* = .03 years	49	*M* = 34.4, *SD* = 4.3; range = 22-51	–	PB, INT, RSE, AP	PRO	MFC	YNG	NA	ACC
van den Branden et al. (2012, 2013, 2015) (visit dentist)	2012	1325	*M* = 5.3 years-old, *SD* = .03 years	49	*M* = 34.4, *SD* = 4.3; range = 22-51	–	PB, INT, MSE, AP	PRO	MFC	YNG	NA	ACC
van den Branden et al. (2012, 2013, 2015) (oral hygiene)	2012	1325	*M* = 5.3 years-old, *SD* = .03 years	49	*M* = 34.4, *SD* = 4.3; range = 22-51	–	PB, ASE, INT, RSE, AP	PRO	MFC	YNG	NA	ACC
van den Branden et al. (2012, 2013, 2015) (oral hygiene)	2012	1325	*M* = 5.3 years-old, *SD* = .03 years	49	*M* = 34.4, *SD* = 4.3; range = 22-51	–	PB, RP, OE, ASE, INT, MSE, RSE, AP, CP	PRO	MFC	YNG	NA	ACC
van den Branden et al. (2012, 2013, 2015) (diet behaviors)	2012	1325	*M* = 5.3 years-old, *SD* = .03 years	49	*M* = 34.4, *SD* = 4.3; range = 22-51	–	RP, OE, ASE, INT, MSE, RSE, AP, CP	PRO	MFC	YNG	NA	ACC
van Lier, Tostmann, Harmsen, Melker, Hautvast, & Ruijs	2016	491	range = 0-4	–	<30 = 94 (19.1%); 30-34 = 189 (38.5%); 35-39 = 148 (30.1%); > 40 = 60 (12.2%	81.7	PB, RP, OE, ASE, INT, MSE, RSE, AP	PRO	PCG	YNG	NA	ACC

Walsh, Edwards, & Fraser	2009	391	range = 0.5-5	–	range = 20-52	97.4	PB, RP, OE, ASE, INT, MSE, RSE, AP	PRO	PCG	YNG	NA	ACC
Wambach	1997	135	Six weeks postpartum	–	*M* = 28.2, *SD* = 5.1; range = 16-40	100	RP, OE, ASE, INT, MSE, RSE, AP	DIE	MFC	YNG	LNG	QUE

Note. [a]Age expressed in years unless otherwise stated; [b]Behavior type moderator coding; [c]Sample type moderator; [d]Child age moderator, samples comprising parents of children with a mean age ≥ 6 years coded as older and samples comprising parent of children with a mean mean age < 6 years coded as younger; [e]Time lag between measures of theory constructs and follow-up measure of behavior moderator – studies with a lag of ≥ 6 weeks coded as long and studies with a lag of < 6 weeks coded as short; [f]Study quality moderator with cut-off values for 'high'/'acceptable' and 'low'/'questionable' studies on the study quality checklist set at 65%, 70%, and 70%. PRO = Protection/safety behaviors; DIE = Dietary behaviors; PA = Physical activity/energy expenditure behaviors; NA = Data not available or coding not possible; MFC = Mothers and female caregivers only; PCG= Parents and caregivers, both genders; OLD = Sample comprising parents of older children; YNG = Sample comprising parents of younger children; SRT = Studies with a shorter time lag between theory measures and behavioral follow up; LNG = Studies with a longer time lag between theory measures and behavioral follow up; ACC = High ('acceptable') quality studies; QUE = Low ('questionable') quality studies.

Appendix D: Study Quality Checklist

Quality Assessment Checklist for Survey Studies in Psychology (Q-SSP)

Study:					
Research domain	**Quality item**	**Yes**	**No**	**Not stated clearly**	**N/A**
Introduction (Rationale)	1. Was the problem or phenomenon under investigation defined, described, and justified?				
Introduction (Rationale)	2. Was the population under investigation defined, described, and justified?				
Introduction (Rationale)	3. Was there a connection between the hypotheses or aims or research questions, and the background research?				
Introduction (Variables)	4. Were operational definitions of all study variables provided?				
Participants (Sampling)	5. Were participant inclusion criteria stated?				
Participants (Sampling)	6. Was the participant recruitment strategy described?				
Participants (Sampling)	7. Was a justification/ rationale for the sample size provided?				
Data (Collection)	8. Was the attrition rate provided? (applies to cross-sectional and prospective studies)				
Data (Analyses)	9. Was a method of treating attrition provided? (applies to cross-sectional and prospective studies)				
Data (Analyses)	10. Were the data analysis techniques justified (i.e., was the link between hypotheses/ aims / research questions and data analyses explained)?				
Data (Measures)	11. Were the measures provided in the report (or in a supplement) in full?				
Data (Measures)	12. Was evidence provided for the validity of the measures (or instrument) used?				
Data (Collection)	13. Was information provided about the person(s) who collected the data (e.g., training, expertise, other demographic characteristics)?				
Data (Collection)	14. Was information provided about the context (e.g., place) of data collection?				
Data (Collection)	15. Was information provided about the duration (or start and end date) of data collection?				
Data (Results)	16. Was the study sample described in terms of key demographic characteristics?				
Data (Discussion)	17. Was discussion of findings confined to the population from which the sample was drawn?				
Ethics	18. Were participants asked to provide (informed) consent or assent?				

Ethics	19. Were participants debriefed at the end of data collection?				
Ethics	20. Were funding sources or conflicts of interest disclosed?				

Appendix E: Zero-Order Correlations and Bias Statistics

Table E1

Zero-Order Parameter Estimates from Meta-Analytic Structural Equation Modeling (Stage 1) for Relations Among Constructs from the Augmented Theory of Planned Behavior for Models Excluding and Including Past Behavior with Heterogeneity and Bias Statistics With Planning Only

Effect	*k*	Model excluding past behavior[a]						Model including past behavior[b]					
		r^+	SE	CI_{95}		I^2	τ^2	r^+	SE	CI_{95}		I^2	τ^2
				LL	UL					LL	UL		
Int-Att	31	.504	.043	.420	.588	96.28	.053	.504	.043	.420	.588	96.26	.053
Int-SN	30	.441	.039	.364	.518	95.13	.042	.441	.039	.364	.518	95.09	.041
Int-PBC	30	.412	.040	.334	.491	95.2	.043	.412	.040	.334	.491	95.17	.043
Int-Plan	4	.517	.077	.366	.668	89.12	.019	.515	.076	.367	.664	88.71	.018
Int-Beh	15	.491	.053	.388	.594	94.16	.036	.490	.052	.388	.593	94.09	.036
Int-PB	15	–	–	–	–	–	–	.494	.075	.347	.641	97.25	.080
Att-SN	28	.422	.035	.354	.490	94.02	.030	.422	.035	.354	.490	94.00	.030
Att-PBC	28	.335	.032	.273	.398	91.89	.024	.335	.032	.273	.398	91.86	.024
Att-Plan	3	.397	.077	.245	.549	84.57	.013	.395	.077	.245	.546	84.16	.012
Att-Beh	18	.311	.044	.224	.397	93.32	.031	.310	.044	.224	.397	93.27	.030
Att-PB	11	–	–	–	–	–	–	.319	.076	.171	.467	96.23	.058
SN-PBC	26	.319	.030	.259	.378	90.12	.020	.319	.030	.259	.378	9.06	.020
SN-Plan	4	.413	.083	.251	.575	90.6	.022	.412	.082	.251	.573	9.43	.022
SN-Beh	14	.395	.042	.313	.476	88.97	.018	.394	.041	.313	.475	88.81	.018
SN-PB	9	–	–	–	–	–	–	.311	.075	.165	.457	95.25	.046
PBC-Plan	5	.399	.064	.273	.524	87.28	.016	.398	.064	.273	.523	87.08	.015
PBC-Beh	19	.368	.038	.293	.443	91.21	.023	.367	.038	.292	.442	91.16	.023
PBC-PB	14	–	–	–	–	–	–	.362	.057	.251	.473	94.59	.040
Plan-Beh	5	.479	.044	.393	.566	68.06	.005	.479	.044	.393	.564	67.30	.005
Plan-PB	4	–	–	–	–	–	–	.570	.103	.369	.771	94.18	.037
Beh-PB	8	–	–	–	–	–	–	.578	.049	.482	.674	86.71	.015

Note. [a]Cochran's *Q* statistic for overall heterogeneity in the model was 2721.676 (df = 245, $p < .001$); [b]Cochran's *Q* statistic for overall heterogeneity in the model was 3325.055 (df = 300, $p < .001$). r^+ = Corrected effect size estimate from random effects meta-analytic structural equation modeling analysis; SE = Standard error; CI_{95} = 95% confidence interval; LL = Lower limit of CI_{95}; UL = Upper limit of CI_{95}; I^2 = Higgins and Thompson's (2002) I^2 statistic for parameter estimate; τ^2 = Estimated variance in population; Int = Intention; Att = Attitude; SN = Subjective norm; PBC = Perceived behavioral control; Plan = Planning; Beh = Behavior; PB = Past behavior.

Table E2

Zero-Order Parameter Estimates from Meta-Analytic Structural Equation Modeling (Stage 1) for Relations Among Constructs from the Theory of Planned Behavior for Models Excluding and Including Past Behavior with Heterogeneity and Bias Statistics Without Planning

Effect	k	Model excluding past behavior[a]						Model including past behavior[b]					
		r^+	SE	CI_{95}		I^2	τ^2	r^+	SE	CI_{95}		I^2	τ^2
				LL	UL					LL	UL		
Int-Att	31	.504	.043	.420	.588	96.28	.053	.504	.043	.420	.588	96.26	.053
Int-SN	30	.441	.039	.364	.519	95.14	.042	.441	.039	.364	.518	95.10	.041
Int-PBC	30	.413	.040	.334	.491	95.20	.043	.412	.040	.334	.491	95.18	.043
Int-Beh	15	.491	.053	.388	.594	94.18	.036	.490	.052	.388	.593	94.11	.036
Int-PB	15	–	–	–	–	–	–	.495	.075	.347	.642	97.26	.080
Att-SN	28	.422	.035	.354	.490	94.03	.030	.422	.035	.354	.490	94.00	.030
Att-PBC	28	.335	.032	.273	.398	91.89	.024	.335	.032	.273	.398	91.86	.024
Att-Beh	18	.311	.044	.224	.397	93.33	.031	.310	.044	.224	.397	93.28	.030
Att-PB	11	–	–	–	–	–	–	.319	.076	.171	.468	96.24	.059
SN-PBC	26	.319	.030	.259	.378	9.14	.020	.319	.030	.259	.378	9.07	.020
SN-Beh	14	.395	.042	.313	.476	89.03	.019	.394	.041	.313	.475	88.87	.018
SN-PB	9	–	–	–	–	–	–	.311	.075	.164	.457	95.27	.046
PBC-Beh	19	.368	.038	.293	.443	91.23	.023	.367	.038	.292	.442	91.18	.023
PBC-PB	14	–	–	–	–	–	–	.362	.057	.251	.473	94.61	.040
Beh-PB	8	–	–	–	–	–	–	.578	.049	.482	.675	86.76	.015

Note. [a]Cochran's Q statistic for overall heterogeneity in the model was 2650.541 (df = 229, $p < .001$); [b]Cochran's Q statistic for overall heterogeneity in the model was 3225.264 (df = 281, $p < .001$). r^+ = Corrected effect size estimate from random effects meta-analytic structural equation modeling analysis; SE = Standard error; CI_{95} = 95% confidence interval; LL = Lower limit of CI_{95}; UL = Upper limit of CI_{95}; I^2 = Higgins and Thompson's (2002) I^2 statistic for parameter estimate; τ^2 = Estimated variance in population; Int = Intention; Att = Attitude; SN = Subjective norm; PBC = Perceived behavioral control; Beh = Behavior; PB = Past behavior.

References

Higgins, J. P. T., & Thompson, S. G. (2002). Quantifying heterogeneity in a meta-analysis. *Statistics in Medicine, 21*, 1539-1558. doi: 10.1002/sim.1186

Appendix F: Conventional Meta-Analysis and Bias Statistics

Table F1

Zero-Order Parameter Estimates from Conventional Fixed and Random Effects Model Meta-Analysis for Relations Among Constructs from the Augmented Theory of Planned Behavior with Heterogeneity and Bias Statistics

Effect	Meta-analytic models										Bias statistics		
	Random effects							Fixed effects		Q	r^{+}_{PET}	r^{+}_{PEESE}	p-BIAS
	k	r^{+}_{RE}	SE	CI$_{95}$ LL	CI$_{95}$ UL	I^2	τ^2	r^{+}_{FE}	SE				
Int-Att	31	.514***	.046	.424	.603	98.677	.062	.636***	.010	1607.326***	.715***	.645***	<.001
Int-SN	30	.450***	.043	.367	.534	97.350	.051	.519***	.010	730.107***	.511***	.518***	<.001
Int-PBC	30	.420***	.043	.335	.505	96.898	.053	.482***	.011	691.589***	.530***	.489***	<.001
Int-Plan[a]	4	.537***	.101	.339	.735	94.992	.039	.565***	.034	52.430***	–	–	–
Int-Beh	15	.506***	.059	.389	.622	97.272	.050	.588***	.015	275.955***	.580***	.577***	<.001
Int-PB	15	.503***	.081	.345	.661	98.828	.096	.530***	.015	640.729***	-.138*	.232***	<.001
Att-SN	28	.432***	.037	.359	.504	96.640	.035	.469***	.008	600.295***	.468***	.463***	<.001
Att-PBC	28	.345***	.035	.277	.414	94.723	.030	.309***	.008	367.798***	.256***	.276***	<.001
Att-Plan[a]	3	.422***	.114	.199	.645	91.567	.036	.413***	.041	23.464***	–	–	–
Att-Beh	18	.322***	.050	.224	.420	99.514	.042	.275***	.009	272.163***	.218***	.249***	<.001
Att-PB	11	.329***	.086	.160	.499	97.321	.079	.303***	.017	250.807***	-.067	.132***	.246
SN-PBC	26	.329***	.034	.263	.394	93.583	.026	.278***	.008	275.446***	.211***	.241***	<.001
SN-Plan[a]	4	.428***	.110	.214	.643	93.725	.045	.428***	.036	44.987***	–	–	–
SN-Beh	14	.416***	.048	.322	.509	90.531	.028	.421***	.018	105.419***	.235***	.362***	<.001
SN-PB	9	.320***	.087	.150	.491	96.606	.065	.282***	.019	179.563***	-.281***	.026	.104
PBC-Plan	5	.411***	.079	.256	.565	90.248	.028	.426***	.031	39.391***	-.227	.089	.370
PBC-Beh	19	.375***	.040	.296	.454	94.565	.027	.246***	.008	426.712***	.115***	.192***	<.001
PBC-PB	14	.370***	.062	.249	.490	95.549	.049	.375***	.016	223.268***	.206***	.331***	<.001
Plan-Beh	5	.493***	.056	.383	.603	83.610	.013	.526***	.031	22.679***	-.105	.204	.678
Plan-PB[a]	4	.585***	.123	.344	.827	97.637	.059	.642***	.034	97.419***	–	–	–
Beh-PB	8	.593***	.051	.492	.693	92.744	.019	.653***	.021	87.893***	.170	.408***	.101

Note. [a]Bias statistics for effects based on small numbers of studies are unlikely to provide reliable estimates, so these statistics have not been computed for effect based on fewer than 5 studies; [b]Only one study tested relations between planning and role construction, so the individual study effect size and variability statistics are reported. r^{+}_{RE} = Corrected effect size estimate from conventional random effects meta-analysis model; r^{+}_{FE} = Corrected effect size estimate from conventional fixed effects meta-analysis model; SE = Standard error; CI$_{95}$ = 95% confidence interval; LL = Lower limit of CI$_{95}$; UL = Upper limit of CI$_{95}$; I^2 = Higgins and Thompson's (2002) I^2 statistic for parameter estimate; τ^2 = Estimated variance in population; Q = Cochran's Q statistic from conventional analyses; r^{+}_{PET} = Effect size estimate corrected for bias using the

precision-effect estimate; r^{+}_{PET} = Effect size estimate corrected for bias using the precision-effect estimate with standard errors; p-BIAS = Probability value for the precision estimate using the PET-PEESE procedure; Int = Intention; Att = Attitude; SN = Subjective norm; PBC = Perceived behavioral control; Plan = Planning; Beh = Behavior; PB = Past behavior.
$^{*}p < .05$ $^{**}p < .01$ $^{***}p < .001$

References

Higgins, J. P. T., & Thompson, S. G. (2002). Quantifying heterogeneity in a meta-analysis. *Statistics in Medicine, 21*, 1539-1558. doi: 10.1002/sim.1186

Appendix G: Model Fit Indexes

Table G1

Fit Indexes for Meta-Analytic Structural Equation Models

Model	N	χ^2	df	p	CFI	TLI	SRMR	RMSEA	RMSEA CI_{95}	
									LL	UL
TPB with planning including past behavior	22607	5.832	3	.120	0.998	0.986	.033	.007	.000	.014
TPB with planning excluding past behavior	22607	10.157	3	.017	0.994	0.969	.049	.010	.004	.018
TPB including past behavior	22607	4.506	2	.105	0.997	0.984	.031	.007	.000	.017
TPB excluding past behavior	22607	9.001	2	.011	0.993	0.963	.041	.012	.005	.021
Moderator: Child age										
Older (6 years and older)	13515	5.376	2	.068	0.995	0.976	.075	.011	.000	.023
Younger (younger than 6 years)	7236	5.406	2	.067	0.995	0.974	.036	.015	.000	.032
Moderator: Time lag										
Proximal	1490	3.318	2	.190	0.999	0.996	.013	.021	.000	.060
Distal	10880	2.776	2	.250	0.997	0.986	.040	.006	.000	.021
Moderator: Sample type										
Mothers/Female caregivers	6769	3.500	2	.174	0.998	0.990	.035	.011	.000	.029
Parents/caregivers	8168	7.547	2	.023	0.987	0.932	.044	.018	.006	.033
Moderator: Behavior										
Dietary behaviors	2688	2.897	2	.235	0.996	0.979	.049	.013	.000	.043
Physical activity/energy expenditure	3462	1.136	2	.567	1.000	1.006	.047	.000	.000	.029
Protection/safety behaviors	15169	5.716	2	.057	0.995	0.976	.046	.011	.000	.022
Moderator: Study quality										
High ('acceptable') quality	2688	2.897	2	.235	0.995	0.979	.049	.013	.000	.043
Low ('questionable') quality	12409	2.794	2	.247	0.998	0.991	.035	.006	.000	.020

Note. N = Total sample size across studies contributing to model; χ^2 = Model goodness-of-fit chi-square relative to independence (totally free) model; df = Degrees of freedom associated with model goodness-of-fit chi-square; p = Probability value for the model goodness-of-fit chi-square; CFI = Comparative fit index; TLI = Tucker-Lewis Index; SRMR = Standardized root mean square residual; RMSEA = Root mean square error of approximation; RMSEA CI_{95} = 95% confidence intervals of RMSEA; LL = Lower limit of the RMSEA 95% confidence interval; UL = Upper limit of the RMSEA 95% confidence interval.

Appendix H: Model Parameter Estimates

Table H1

Standardized Path Coefficients for Direct and Indirect Effects for the Meta-Analytic Structural Equation Model (Stage 2) of the Theory of Planned Behavior Excluding and Including Past Behavior with Model Comparisons with Planning

Effect	Model excluding past behavior			Model including past behavior			Model comparisons[a]		
	β	Wald CI_{95}		β	Wald CI_{95}		β_{diff}	CI_{95}	
		LL	UL		LL	UL		LL	UL
Direct effects									
Intention→Behavior	.329	.160	.497	.240	.049	.430	.089	-.165	.343
PBC→Behavior	.150	.035	.265	.094	-.033	.221	.056	-.115	.227
Planning→Behavior	.255	.099	.411	.098	-.147	.342	.158	-.132	.447
Attitude→Intention	.369	.260	.477	.301	.175	.428	.067	-.099	.234
PBC→Intention	.202	.100	.304	.172	.055	.288	.031	-.124	.186
SN→Intention	.239	.127	.352	.187	.055	.320	.052	-.122	.226
Intention→Planning	.477	.317	.637	.309	.074	.544	.168	-.116	.452
PB→Attitude	–	–	–	.344	.219	.469	–	–	–
PB→Behavior	–	–	–	.392	.210	.573	–	–	–
PB→Intention	–	–	–	.214	.023	.404	–	–	–
PB→PBC	–	–	–	.359	.248	.471	–	–	–
PB→Planning	–	–	–	.431	.163	.699	–	–	–
PB→SN	–	–	–	.393	.266	.519	–	–	–
Indirect effects									
Attitude→Intention→Behavior	.121	.056	.186	.072	.007	.137	.049	-.043	.141
SN→Intention→Behavior	.079	.019	.139	.045	-.009	.098	.034	-.047	.114
PBC→Intention→Behavior	.066	.019	.114	.041	-.003	.086	.025	-.040	.090
Intention→Planning→Behavior	.122	.043	.200	.030	-.047	.108	.092	-.019	.202
PB→Attitude→Intention→Behavior	–	–	–	.025	.004	.046	–	–	–
PB→SN→Intention→Behavior	–	–	–	.018	-.003	.038	–	–	–
PB→PBC→Intention→Behavior	–	–	–	.015	-.002	.031	–	–	–
PB→Intention→Planning→Behavior	–	–	–	.006	-.012	.025	–	–	–
PB→Intention→Behavior	–	–	–	.051	.002	.101	–	–	–

PB→Planning→Behavior	–	–	–	.042	-.054	.138	–	–	–
PB→PBC→Behavior	–	–	–	.034	-.008	.076	–	–	–
PB→Behavior[b]	–	–	–	.191	.093	.288	–	–	–
Total effects									
PB→Behavior[c]	–	–	–	.582	.479	.685	–	–	–
Correlations									
Attitude↔PBC	.337	.275	.400	.211	.124	.298	.126	.019	.233
SN↔PBC	.326	.267	.385	.180	.092	.269	.145	.039	.252
PBC↔Planning	.176	.020	.331	.106	-.051	.264	.070	-.152	.291
SN↔Planning	.234	.048	.421	.111	-.114	.335	.124	-.168	.416
Attitude↔SN	.423	.355	.491	.286	.191	.381	.136	.019	.254

Note. β = Standardized path coefficient; Wald CI_{95} = Wald 95% confidence interval; LL = Lower limit of CI_{95}; UL = Upper limit of CI_{95}; CI_{95} = Conventional 95% confidence interval; β_{diff} = Difference in standardized path coefficient; SN = Subjective norms; PBC = Perceived behavioral control; PB = Past behavior; [a]Model comparisons made using Schenker and Gentleman's (2001) 'standard method' using confidence intervals about the mean difference; [b]Sum of indirect effects of past behavior on behavior; [c]Total effect of past behavior on behavior.

Table H2

Standardized Path Coefficients for Direct and Indirect Effects for the Meta-Analytic Structural Equation Model (Stage 2) of the Theory of Planned Behavior Excluding and Including Past Behavior with Model Comparisons and Without Planning

Effect	Model excluding past behavior			Model including past behavior			Model comparisons[a]		
	β	Wald CI_{95}		β	Wald CI_{95}		$β_{diff}$	CI_{95}	
		LL	UL		LL	UL		LL	UL
Direct effects									
Intention→Behavior	.482	.370	.594	.277	.117	.437	.205	.010	.401
PBC→Behavior	.188	.078	.298	.106	-.023	.235	.082	-.088	.252
Attitude→Intention	.319	.211	.427	.296	.171	.420	.024	-.141	.189
PBC→Intention	.198	.099	.298	.169	.052	.285	.030	-.124	.183
SN→Intention	.285	.184	.385	.186	.052	.320	.099	-.069	.266
PB→Attitude	–	–	–	.317	.191	.442	–	–	–
PB→Behavior	–	–	–	.433	.292	.573	–	–	–
PB→Intention	–	–	–	.230	.042	.418	–	–	–
PB→PBC	–	–	–	.354	.242	.467	–	–	–
PB→SN	–	–	–	.398	.275	.520	–	–	–
Indirect effects									
Attitude→Intention→Behavior	.154	.095	.213	.082	.023	.141	.072	-.011	.156
SN→Intention→Behavior	.137	.079	.196	.051	-.001	.104	.086	.007	.165
PBC→Intention→Behavior	.096	.039	.152	.047	.004	.089	.049	-.022	.119
PB→Attitude→Intention→Behavior	–	–	–	.026	.008	.043	–	–	–
PB→SN→Intention→Behavior	–	–	–	.020	.001	.040	–	–	–
PB→PBC→Intention→Behavior	–	–	–	.017	.001	.032	–	–	–
PB→Intention→Behavior	–	–	–	.064	.010	.118	–	–	–
PB→PBC→Behavior	–	–	–	.038	-.004	.079	–	–	–
PB→Behavior[b]	–	–	–	.164	.097	.232	–	–	–
Total effects									
PB→Behavior[c]	–	–	–	.597	.502	.691	–	–	–

Correlations									
Attitude↔PBC	.336	.274	.398	.223	.137	.309	.113	.007	.219
SN↔PBC	.328	.269	.388	.181	.092	.270	.147	.040	.254
Attitude↔SN	.422	.353	.490	.295	.200	.390	.126	.009	.243

Note. β = Standardized path coefficient; Wald CI_{95} = Wald 95% confidence interval; LL = Lower limit of CI_{95}; UL = Upper limit of CI_{95}; CI_{95} = Conventional 95% confidence interval; β_{diff} = Difference in standardized path coefficient; SN = Subjective norms; PBC = Perceived behavioral control; PB = Past behavior; [a]Model comparisons made using Schenker and Gentleman's (2001) 'standard method' using confidence intervals about the mean difference; [b]Sum of indirect effects of past behavior on behavior; [c]Total effect of past behavior on behavior.

Table H3

Standardized Path Coefficients for Direct and Indirect Effects for the Meta-Analytic Structural Equation Model (Stage 2) of the Theory of Planned Behavior for the Child Age Moderator Analysis with Model Comparisons

Effect	Studies on younger children (≤6 years old)			Studies on older children (>6 years old)			Model comparisons[a]		
	β	Wald CI_{95}		β	Wald CI_{95}		β_{diff}	CI_{95}	
		LL	UL		LL	UL		LL	UL
Direct effects									
Intention→Behavior	.463	.382	.544	.484	.355	.613	-.021	-.174	.131
PBC→Behavior	.185	.015	.354	.178	.038	.318	.006	-.214	.226
Attitude→Intention	.238	.019	.456	.359	.220	.499	-.122	-.381	.137
PBC→Intention	.217	.055	.379	.208	.063	.353	.009	-.209	.226
SN→Intention	.280	.030	.530	.288	.168	.408	-.009	-.286	.269
Indirect effects									
Attitude→Intention→Behavior	.110	.008	.212	.174	.097	.251	-.064	-.192	.064
SN→Intention→Behavior	.129	.010	.249	.140	.072	.207	-.010	-.148	.127
PBC→Intention→Behavior	.100	.024	.177	.101	.020	.182	.000	-.112	.111
Correlations									
Attitude↔PBC	.327	.223	.430	.314	.224	.403	.013	-.124	.150
SN↔PBC	.311	.201	.421	.347	.266	.428	-.036	-.172	.101
Attitude↔SN	.468	.323	.614	.444	.363	.526	.024	-.142	.191

Note. β = Standardized path coefficient; Wald CI_{95} = Wald 95% confidence interval; LL = Lower limit of CI_{95}; UL = Upper limit of CI_{95}; CI_{95} = Conventional 95% confidence interval; β_{diff} = Difference in standardized path coefficient; SN = Subjective norms; PBC = Perceived behavioral control; [a]Model comparisons made using Schenker and Gentleman's (2001) 'standard method' using confidence intervals about the mean difference.

Table H4

Standardized Path Coefficients for Direct and Indirect Effects for the Meta-Analytic Structural Equation Model (Stage 2) of the Theory of Planned Behavior for the Time Lag Moderator Analysis with Model Comparisons

Effect	Studies with shorter time lag (≤6 weeks)			Studies with longer time lag (>6 weeks)			Model comparisons[a]		
	β	Wald CI_{95}		β	Wald CI_{95}		$β_{diff}$	CI_{95}	
		LL	UL		LL	UL		LL	UL
Direct effects									
Intention→Behavior	.469	.385	.553	.467	.277	.657	.002	-.205	.210
PBC→Behavior	.215	.110	.320	.059	-.129	.248	.155	-.061	.371
Attitude→Intention	.296	.219	.373	.260	.044	.477	.035	-.195	.265
PBC→Intention	.299	.237	.361	.266	.110	.423	.033	-.136	.201
SN→Intention	.394	.300	.488	.291	.119	.462	.103	-.092	.299
Indirect effects									
Attitude→Intention→Behavior	.139	.095	.182	.122	.009	.234	.017	-.103	.137
SN→Intention→Behavior	.185	.131	.239	.136	.043	.228	.049	-.058	.156
PBC→Intention→Behavior	.140	.099	.181	.124	.026	.222	.016	-.090	.122
Correlations									
Attitude↔PBC	.399	.343	.455	.341	.193	.488	.059	-.099	.217
SN↔PBC	.477	.423	.531	.357	.235	.479	.120	-.013	.254
Attitude↔SN	.549	.462	.637	.420	.293	.547	.129	-.025	.283

Note. β = Standardized path coefficient; Wald CI_{95} = Wald 95% confidence interval; LL = Lower limit of CI_{95}; UL = Upper limit of CI_{95}; CI_{95} = Conventional 95% confidence interval; $β_{diff}$ = Difference in standardized path coefficient; SN = Subjective norms; PBC = Perceived behavioral control; [a]Model comparisons made using Schenker and Gentleman's (2001) 'standard method' using confidence intervals about the mean difference.

Table H5

Standardized Path Coefficients for Direct and Indirect Effects for the Meta-Analytic Structural Equation Model (Stage 2) of the Theory of Planned Behavior for the Sample Type Moderator Analysis with Model Comparisons

Effect	Studies on mothers/female cargivers			Studies on parents/caregivers			Model comparisons[a]		
	β	Wald CI_{95}		β	Wald CI_{95}		$β_{diff}$	CI_{95}	
		LL	UL		LL	UL		LL	UL
Direct effects									
Intention→Behavior	.530	.372	.688	.413	.275	.551	.117	-.093	.327
PBC→Behavior	.137	-.036	.311	.287	.169	.404	-.149	-.359	.060
Attitude→Intention	.300	.157	.442	.334	.166	.502	-.034	-.255	.186
PBC→Intention	.219	.088	.350	.153	.007	.300	.065	-.131	.262
SN→Intention	.313	.179	.446	.267	.129	.405	.046	-.146	.238
Indirect effects									
Attitude→Intention→Behavior	.159	.075	.242	.138	.059	.217	.021	-.094	.136
SN→Intention→Behavior	.166	.079	.252	.110	.042	.179	.055	-.055	.166
PBC→Intention→Behavior	.116	.032	.199	.063	-.003	.129	.053	-.054	.159
Correlations									
Attitude↔PBC	.352	.289	.415	.319	.198	.441	.033	-.104	.170
SN↔PBC	.350	.269	.430	.328	.239	.416	.022	-.098	.141
Attitude↔SN	.530	.419	.539	.355	.231	.480	.124	-.014	.262

Note. β = Standardized path coefficient; Wald CI_{95} = Wald 95% confidence interval; LL = Lower limit of CI_{95}; UL = Upper limit of CI_{95}; CI_{95} = Conventional 95% confidence interval; $β_{diff}$ = Difference in standardized path coefficient; SN = Subjective norms; PBC = Perceived behavioral control; [a]Model comparisons made using Schenker and Gentleman's (2001) 'standard method' using confidence intervals about the mean difference.

Table H6

Standardized Path Coefficients for Direct and Indirect Effects for the Meta-Analytic Structural Equation Model (Stage 2) of the Theory of Planned Behavior for the Behavior Type Moderator Analysis (Dietary Behaviors vs. Physical Activity/Energy Expenditure Behaviors) with Model Comparisons

Effect	Dietary behaviors			Physical activity/ Energy expenditure behaviors			Model comparisons[a]		
	β	Wald CI_{95}		β	Wald CI_{95}		β_{diff}	CI_{95}	
		LL	UL		LL	UL		LL	UL
Direct effects									
Intention→Behavior	.500	.294	.706	.488	.384	.592	.012	-.219	.243
PBC→Behavior	.176	-.090	.443	.253	.134	.373	-.077	-.369	.215
Attitude→Intention	.336	.152	.521	.135	-.198	.468	.202	-.179	.582
PBC→Intention	.089	-.082	.260	.199	-.050	.448	-.110	-.412	.192
SN→Intention	.203	.031	.375	.567	.300	.834	-.364	-.682	-.047
Indirect effects									
Attitude→Intention→Behavior	.168	.054	.283	.066	-.097	.229	.102	-.097	.302
SN→Intention→Behavior	.101	.005	.198	.277	.152	.402	-.175	-.333	-.018
PBC→Intention→Behavior	.044	-.044	.133	.097	-.031	.225	-.053	-.208	.103
Correlations									
Attitude↔PBC	.299	.177	.422	.294	.154	.434	.005	-.181	.191
SN↔PBC	.306	.177	.434	.405	.221	.589	-.099	-.324	.125
Attitude↔SN	.401	.318	.484	.446	.131	.761	-.045	-.370	.281

Note. β = Standardized path coefficient; Wald CI_{95} = Wald 95% confidence interval; LL = Lower limit of CI_{95}; UL = Upper limit of CI_{95}; CI_{95} = Conventional 95% confidence interval; β_{diff} = Difference in standardized path coefficient; SN = Subjective norms; PBC = Perceived behavioral control; [a]Model comparisons made using Schenker and Gentleman's (2001) 'standard method' using confidence intervals about the mean difference.

Table H7
Standardized Path Coefficients for Direct and Indirect Effects for the Meta-Analytic Structural Equation Model (Stage 2) of the Theory of Planned Behavior for the Behavior Type Moderator Analysis (Dietary Behaviors vs. Protection/Safety Behaviors) with Model Comparisons

Effect	Dietary behaviors			Protection/Safety behaviors			Model comparisons[a]		
	β	Wald CI_{95}		β	Wald CI_{95}		β_{diff}	CI_{95}	
		LL	UL		LL	UL		LL	UL
Direct effects									
Intention→Behavior	.500	.294	.706	.475	.319	.630	.025	-.233	.283
PBC→Behavior	.176	-.090	.443	.126	-.045	.298	.050	-.267	.367
Attitude→Intention	.336	.152	.521	.373	.239	.507	-.037	-.264	.191
PBC→Intention	.089	-.082	.260	.284	.165	.402	-.195	-.403	.013
SN→Intention	.203	.031	.375	.270	.168	.373	-.068	-.268	.133
Indirect effects									
Attitude→Intention→Behavior	.168	.054	.283	.177	.099	.255	-.009	-.147	.129
SN→Intention→Behavior	.101	.005	.198	.128	.062	.195	-.027	-.144	.090
PBC→Intention→Behavior	.044	-.044	.133	.135	.056	.213	-.090	-.208	.028
Correlations									
Attitude↔PBC	.299	.177	.422	.369	.281	.458	-.070	-.222	.081
SN↔PBC	.306	.177	.434	.314	.244	.384	-.009	-.155	.138
Attitude↔SN	.401	.318	.484	.437	.343	.531	-.036	-.161	.089

Note. β = Standardized path coefficient; Wald CI_{95} = Wald 95% confidence interval; LL = Lower limit of CI_{95}; UL = Upper limit of CI_{95}; CI_{95} = Conventional 95% confidence interval; β_{diff} = Difference in standardized path coefficient; SN = Subjective norms; PBC = Perceived behavioral control; [a]Model comparisons made using Schenker and Gentleman's (2001) 'standard method' using confidence intervals about the mean difference.

Table H8

Standardized Path Coefficients for Direct and Indirect Effects for the Meta-Analytic Structural Equation Model (Stage 2) of the Theory of Planned Behavior for the Behavior Type Moderator Analysis (Physical Activity/Energy Expenditure Behaviors vs. Protection/Safety Behaviors) with Model Comparisons

Effect	Physical activity/ Energy expenditure behaviors			Protection/Safety behaviors			Model comparisons[a]		
	β	Wald CI_{95}		β	Wald CI_{95}		$β_{diff}$	CI_{95}	
		LL	UL		LL	UL		LL	UL
Direct effects									
Intention→Behavior	.488	.384	.592	.475	.319	.630	.013	-.174	.200
PBC→Behavior	.253	.134	.373	.126	-.045	.298	.127	-.082	.336
Attitude→Intention	.135	-.198	.468	.373	.239	.507	-.238	-.597	.120
PBC→Intention	.199	-.050	.448	.284	.165	.402	-.085	-.360	.190
SN→Intention	.567	.300	.834	.270	.168	.373	.297	.011	.583
Indirect effects									
Attitude→Intention→Behavior	.066	-.097	.229	.177	.099	.255	-.111	-.292	.070
SN→Intention→Behavior	.277	.152	.402	.128	.062	.195	.148	.007	.290
PBC→Intention→Behavior	.097	-.031	.225	.135	.056	.213	-.038	-.188	.112
Correlations									
Attitude↔PBC	.294	.154	.434	.369	.281	.458	-.075	-.241	.090
SN↔PBC	.405	.221	.589	.314	.244	.384	.091	-.106	.288
Attitude↔SN	.446	.131	.761	.437	.343	.531	.009	-.320	.337

Note. β = Standardized path coefficient; Wald CI_{95} = Wald 95% confidence interval; LL = Lower limit of CI_{95}; UL = Upper limit of CI_{95}; CI_{95} = Conventional 95% confidence interval; $β_{diff}$ = Difference in standardized path coefficient; SN = Subjective norms; PBC = Perceived behavioral control; [a]Model comparisons made using Schenker and Gentleman's (2001) 'standard method' using confidence intervals about the mean difference.

Table H9

Standardized Path Coefficients for Direct and Indirect Effects for the Meta-Analytic Structural Equation Model (Stage 2) of the Theory of Planned Behavior for the Study Quality Moderator Analysis with a Checklist Cut-off Value Set at 65% with Model Comparisons

Effect	High (acceptable) quality studies			Low (questionable) quality studies			Model comparisons[a]		
	β	Wald CI_{95}		β	Wald CI_{95}		$β_{diff}$	CI_{95}	
		LL	UL		LL	UL		LL	UL
Direct effects									
Intention→Behavior	.385	.257	.514	.615	.445	.785	-.230	-.442	-.017
PBC→Behavior	.261	.134	.388	.092	-.095	.280	.169	-.058	.395
Attitude→Intention	.280	.116	.443	.354	.213	.495	-.074	-.290	.141
PBC→Intention	.207	.083	.331	.180	.020	.339	.028	-.175	.230
SN→Intention	.293	.153	.433	.293	.153	.432	.000	-.197	.198
Indirect effects									
Attitude→Intention→Behavior	.108	.038	.177	.218	.122	.314	-.110	-.229	.009
SN→Intention→Behavior	.113	.046	.180	.180	.083	.277	-.067	-.185	.051
PBC→Intention→Behavior	.080	.023	.137	.110	.000	.221	-.031	-.154	.093
Correlations									
Attitude↔PBC	.345	.244	.446	.327	.255	.399	.018	-.107	.142
SN↔PBC	.357	.282	.431	.302	.212	.392	.055	-.062	.171
Attitude↔SN	.423	.319	.527	.421	.330	.512	.002	-.136	.140

Note. β = Standardized path coefficient; Wald CI_{95} = Wald 95% confidence interval; LL = Lower limit of CI_{95}; UL = Upper limit of CI_{95}; CI_{95} = Conventional 95% confidence interval; $β_{diff}$ = Difference in standardized path coefficient; SN = Subjective norms; PBC = Perceived behavioral control; [a]Model comparisons made using Schenker and Gentleman's (2001) 'standard method' using confidence intervals about the mean difference.

Table H10

Standardized Path Coefficients for Direct and Indirect Effects for the Meta-Analytic Structural Equation Model (Stage 2) of the Theory of Planned Behavior for the Study Quality Moderator Analysis with a Checklist Cut-off Value Set at 70% with Model Comparisons

Effect	High (acceptable) quality studies			Low (questionable) quality studies			Model comparisons[a]		
	β	Wald CI_{95}		β	Wald CI_{95}		$β_{diff}$	CI_{95}	
		LL	UL		LL	UL		LL	UL
Direct effects									
Intention→Behavior	.366	.252	.480	.589	.426	.753	-.224	-.423	-.024
PBC→Behavior	.285	.141	.429	.122	-.039	.282	.163	-.052	.379
Attitude→Intention	.210	.030	.391	.370	.246	.494	-.160	-.379	.059
PBC→Intention	.203	.072	.335	.182	.040	.324	.021	-.172	.215
SN→Intention	.330	.195	.464	.297	.168	.426	.033	-.153	.219
Indirect effects									
Attitude→Intention→Behavior	.077	.008	.146	.218	.134	.303	-.141	-.250	-.032
SN→Intention→Behavior	.121	.057	.184	.175	.086	.264	-.054	-.164	.055
PBC→Intention→Behavior	.074	.020	.128	.107	.012	.203	-.033	-.143	.077
Correlations									
Attitude↔PBC	.356	.237	.475	.316	.250	.382	.040	-.096	.176
SN↔PBC	.368	.303	.432	.305	.217	.393	.062	-.047	.172
Attitude↔SN	.383	.265	.501	.442	.359	.525	-.059	-.203	.085

Note. β = Standardized path coefficient; Wald CI_{95} = Wald 95% confidence interval; LL = Lower limit of CI_{95}; UL = Upper limit of CI_{95}; CI_{95} = Conventional 95% confidence interval; $β_{diff}$ = Difference in standardized path coefficient; SN = Subjective norms; PBC = Perceived behavioral control; [a]Model comparisons made using Schenker and Gentleman's (2001) 'standard method' using confidence intervals about the mean difference.

Table H11
Standardized Path Coefficients for Direct and Indirect Effects for the Meta-Analytic Structural Equation Model (Stage 2) of the Theory of Planned Behavior for the Study Quality Moderator Analysis with a Checklist Cut-off Value Set at 75% with Model Comparisons

Effect	High (acceptable) quality studies			Low (questionable) quality studies			Model comparisons[a]		
	β	Wald CI_{95}		β	Wald CI_{95}		$β_{diff}$	CI_{95}	
		LL	UL		LL	UL		LL	UL
Direct effects									
Intention→Behavior	.362	.159	.565	.515	.392	.639	-.153	-.391	.084
PBC→Behavior	.388	.203	.572	.144	.020	.268	.244	.021	.466
Attitude→Intention	.262	-.040	.564	.327	.222	.432	-.065	-.385	.255
PBC→Intention	.150	-.060	.360	.203	.090	.315	-.053	-.291	.186
SN→Intention	.241	.056	.425	.312	.203	.420	-.071	-.285	.143
Indirect effects									
Attitude→Intention→Behavior	.095	-.026	.216	.169	.107	.231	-.074	-.210	.062
SN→Intention→Behavior	.087	.001	.173	.161	.093	.228	-.074	-.183	.036
PBC→Intention→Behavior	.054	-.026	.134	.104	.037	.172	-.050	-.155	.055
Correlations									
Attitude↔PBC	.425	.234	.616	.320	.260	.381	.105	-.096	.305
SN↔PBC	.332	.281	.382	.323	.250	.396	.009	-.080	.098
Attitude↔SN	.388	.245	.530	.430	.353	.507	-.043	-.205	.119

Note. β = Standardized path coefficient; Wald CI_{95} = Wald 95% confidence interval; LL = Lower limit of CI_{95}; UL = Upper limit of CI_{95}; CI_{95} = Conventional 95% confidence interval; $β_{diff}$ = Difference in standardized path coefficient; SN = Subjective norms; PBC = Perceived behavioral control; [a]Model comparisons made using Schenker and Gentleman's (2001) 'standard method' using confidence intervals about the mean difference.

References

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